RAILROAD GAZETTE

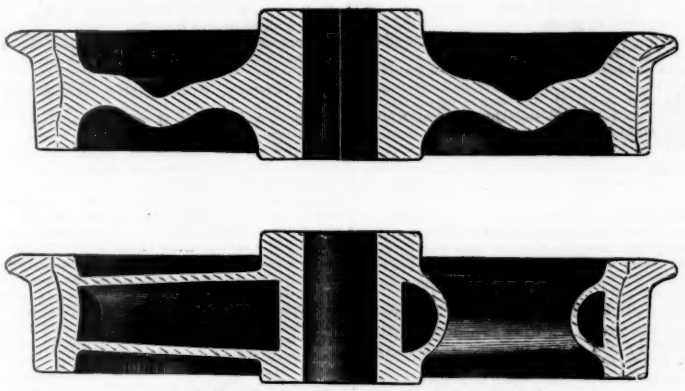
SATURDAY, JULY 6, 1872.

Sax & Kear's Patent Steel-tired Car Wheel.

The engravings show sections of a steel-tired car wheel made by processes the patents for which are owned by Sax & Kear, of Pittston, Luzerne county, Pa. The plate wheel (the upper section) shows the thick tire, and the spoke wheel the thin one, the processes being distinct for the two. The thick tire is to be turned to a finished form, and the thin tire is said to leave the mold a perfect circle, requiring no turning or finishing, and needing only to be bored to receive the axle to be ready for work. The processes for making these wheels are the subject of two separate patents, and may be briefly described as follows: The steel tire is made in the same manner as the tires of the driving wheels of locomotives—first cast in an ingot, then drawn under a steam hammer, then rolled in rough and finishing rolls, and finally pressed into a perfectly circular form by machinery specially adapted to this purpose.

Up to this point the process is the same for the manufacture of both the thick and the thin tires. If the tires are thick, they are taken to the molding room, where a suitable heating furnace is used, in which the tires are placed and heated until their surfaces assumes a pasty or fusible condition. The tires are then placed in the molds, and the molten iron is poured in to form the center of the wheel. The iron unites with the inner surface of the tire, and this being also at a welding heat, the two are joined solidly together, forming a complete union of the two metals without any strain or pressure on the center of the wheel or the tire. After cooling, the wheel is placed in a lathe, and the outer face or tread of the tire is turned perfectly true, when it is ready for use. This thick-tired wheel, when thus made and finished, is said to be entirely satisfactory for actual service, but, owing to the amount of steel required and the reheating processes, is so expensive as to prevent its general adoption for the wheels of freight and coal cars.

To overcome this difficulty, and to render the wheel a cheap one, without detracting from its durability, was the problem which Mr. Sax believes he has solved by the following process, adopted after a long series of experiments and failures: This



Sax & Kear's Patent Steel-tired Car Wheel.

is the subject of his second patent. With this he uses tires from one-fourth to three-fourths of an inch in thickness, and claims to make a wheel which is perfectly circular when it leaves the mold.

In this second process a flask of cast iron is used, in which the steel tire is placed and locked so as to be perfectly immovable. This flask, from its manner of holding the tire, is termed a compress. In this compress and outside of the steel tire is a vacant space, into which to pour molten metal to heat the thin steel tire to a state that will enable it to unite and weld perfectly with the iron of the wheel, which is poured after the heat from the ring of molten metal on the outside of the tire has heated it to a proper state for uniting with the wheel. As the tire is cold when the metal is poured into the compress and the quantity of metal small, there is no union on the outside; while on the inside is formed a weld which the inventor says is as perfect as can be obtained by the expensive process of heating furnaces, etc., used for the thick tire. As the steel tire and cast center form a homogeneous weld, they are substantially one piece of metal, making impossible such an accident as the bursting of a tire and allowing the steel to be entirely worn out before the wheel is thrown aside. By this process, also, it is said that a steel of much higher grade can be used than would be possible with the tire shrunk on, giving a harder surface to resist the wear of the rail and thus increasing the life of the wheel, while at the same time not more than one-half the quantity of steel is used. It also obviates all necessity for set screws and other appliances for keeping the wheel and tire together.

These wheels are now being manufactured by the Washburn Iron Company of Worcester, Mass., under license from the patentees for the New England States. The Taylor Iron Works is about to begin manufacturing them. The wheels are in use on the Erie Railway, Central of New Jersey, Boston & Albany, Worcester & Nashua and other railroads in the Eastern and Middle States, and doubtless the proprietors of the patent, named above, will be glad to give the reports of the experience of these roads.

THE MASTER MECHANICS' ASSOCIATION.

Official Report of the Fifth Annual Convention.

FIRST DAY.

The meeting was called to order at 9:30 a. m., June 11, 1872, by the President, H. M. Britton, of Cincinnati.

Prayer was offered by the Rev. Mr. Hughes.

THE PRESIDENT.—The first business in order will be to receive the minutes of the last meeting. They have been printed in pamphlet form, which would require a long time to read. Is it your pleasure that they be approved without reading?

On motion of Mr. Jackson, of the Rome, Watertown & Ogdensburgh Railroad, it was voted that the minutes as printed be approved.

THE PRESIDENT.—The next business in order is the calling of the roll. Members will now pay attention to the calling of the roll and answer to their names as called.

Mr. EDDY, of the Boston & Albany Railroad.—Perhaps our roll would be a little fuller if we gave some here a chance to become members who are not, previous to the calling of the roll.

THE SECRETARY.—The next business in order is signing the constitution. We want to see who of the old members are present first.

The roll was then called, and the members present answered to their names.

THE PRESIDENT.—There will be an opportunity now offered for those who wish to sign the constitution to do so. Before signing, however, the Secretary will read the article.

THE SECRETARY.—Art. 4, Sec. 1. The following persons may become members of the Association by signing the constitution, or authorizing the President or Secretary of the Association to sign for them, and paying the initiation fee of one dollar: Any persons having charge of the mechanical department of a railway, known as "Superintendents," or "Master Mechanics," or "General Foremen," the names of the latter being presented by their superior officers for membership.

The President then read his address as follows:

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE ASSOCIATION: I am happy to meet you again in open convention. We have met here in the city of Boston on this, the 11th day of June, 1872, to celebrate our fifth anniversary.

At Louisville, Ky., it was voted to change the time of holding our annual meeting from the second Tuesday in September to the second Tuesday in May. During the early part of this year your General Supervisory Committee received quite a number of letters from the members of the Association, wishing to know if the annual meeting for this year could not be held in June instead of May. Your Committee therefore prepared and sent out a circular to the members, requesting an answer either for or against a change in the time of holding the annual meeting for this year. Answers were received from 131 members, 125 requesting the time of holding the meeting to be June 18. Your Committee found that accommodations could not be had for the 18th, on account of its being the week of the great Peace Jubilee; they therefore considered it best to meet on the 11th of June. I hope this change has not inconvenienced any member.

Some of our members who live in the cold sections have informed me that they think May rather early to hold our annual meeting. After a very cold winter, they find it difficult to leave their business long enough to attend our meeting. It would be well to select the place of holding our next meeting early in the session, and then determine on the time of holding it which will suit the members best.

Great credit is due the various committees for the excellent reports which they presented at our last annual meeting, which your Committee on Printing have had printed in pamphlet form. Your Secretary has mailed a copy to each member, and to the officers of railroads, as far as he has known their addresses.

A number of the last, and also of the third and fourth annual reports, are still on hand, and will be supplied to members, on application either personally or by letter. By having the first and second annual reports reprinted—with which few of the members are supplied—it will be possible for those who wish to do so to preserve the series complete and have them bound in one volume.

It is thought that the reports of your committees have been the means of diffusing much valuable information to those engaged in operating and constructing railroad machinery, and that the plan which you have adopted of collecting and recording the experience and knowledge of those engaged in the same occupation in different parts of the country may be extended very much farther, and that the system of transacting business which you have adopted has been much more successful than was expected by those who organized it.

I would recommend that a committee be selected early in the session to present to this Convention subjects for our consideration at the next annual meeting, so that there may be ample time for appointing the committees before we adjourn. In some cases members cannot serve on committees. If they are appointed late in the session—which has been our custom—no time is given to appoint others in their place until some days after we adjourn, which often detains the committees in beginning their work.

Mr. Perry, of the Cheshire railroad, was appointed Chairman of the Committee on Tires at our last meeting, although he was not present. As soon as he was notified of his appointment, however, he requested to be excused from serving, on account of business. His request was complied with, and Mr. Lauder, of the Northern Railroad, appointed in his place. The time was then so short that they feared they could not prepare a report for this meeting. Should the Convention wish to continue this committee, we may look for a long and interesting report at our next meeting.

Boiler explosions are becoming quite frequent. Scarcely a day passes but we hear of one or more. A very small percentage of these are locomotive boilers, yet enough to show us the necessity of using every care possible in their construction and use.

I think a commission has been appointed by Congress to experiment for the purpose of determining certain rules for the construction of boilers. If such a commission has been appointed, I would recommend that this Convention send a committee to be present at such experiments as may be made and gather all the information possible and report at our next meeting.

Since our last meeting, the duties of your Secretary have been quite arduous, requiring him to obtain help. I am happy to say the duties of his office have been attended to in the best manner possible. I congratulate the Association for selecting Mr. Setchel for this important office, and trust he may be induced to serve another year.

I would especially urge upon all the members the importance of discussion. After the various reports have been presented to the Convention, there should be a free interchange of opinions. Our Association is intended for the purpose of investigating all matters connected with railway machinery.

So long as master mechanics have as much human nature in them as most of them now display, there will be differences of opinion; let us, however, trust that each and every one will aim chiefly to learn the most effective and economical manner of constructing and working railroad machinery. The committees will doubtless present reports which will contain valuable facts and information, but should any member hold different views from those advanced by the committees, or should his experience suggest any modification or addition to their conclusions, I trust he will so state it to this Convention. By so doing we shall arrive at facts that can be reached in no other way.

Much has been said about the hospitality extended to us by our friends at our meetings. It is pleasant to know that we have friends who thus manifest their good feeling to us in the cities where we hold our conventions, yet we should be careful not to accept anything that will cast a shadow on the reputation of our institution. There is much to interest us in and about this great city, and which may tend to take the members away from our sessions. Our by-laws specify that one session shall be held each day, from 9 a. m. till 2 p. m. I hope each member will so arrange as to devote his time to the Convention each day while it lasts, thus enabling us to dispatch the business satisfactorily, which cannot be done if the members are absent.

Such committees as are not ready to report will confer a favor by making it known before their reports are called for.

Gentlemen, I have served you since the organization of our Association, in 1868, as your President. I have endeavored to do so to the best of my ability, but feeling that there are many members better qualified for the position, it is but fair, and I request you to select a successor at our election of officers. Thanking you for the many acts of kindness shown me since the formation of this Association, again I thank you for your attention while I have been making these few imperfect remarks. To you as a body I now commit this Convention.

The Treasurer's report was then read by the Secretary, as follows:

TREASURER'S REPORT.

JUNE 11, 1872.

S. J. HAYES, Treasurer,
In account with
AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

September, 1871, to June, 1872.	DR.	
To receipts and assessments to date	$1,449	00
To W. W. Evans, contribution	20	00
To A. P. Burroughs, initiation fee	1	00
Total	$1,470	00
June 11, To balance on hand	$58	65

September, 1871, to June, 1872.			CR.	
By balance due Treasurer as per last acct.			$254	85
By H. M. Britton	Voucher No.	1.	18	00
By M. E. Jones	"	2.	40	00
By L. P. Dodge	"	3.	10	00
By L. P. Dodge	"	4.	15	50
By L. P. Dodge	"	5.	500	00
By J. E. Pettibone	"	6.	2	50
By Bosworth, Chase & H.	"	7.	14	00
By D. A. Cashman	"	8.	7	00
By Wilstach, Baldwin & Co.	"	9.	3	50
By Wilstach, Baldwin & Co	"	10.	149	00
By Wilstach, Baldwin & Co.	"	11.	337	00
By S. J. Hayes	"	12.	6	00
By Wilstach, Baldwin & Co.	"	13.	12	50
By J. H. Setchel, on acct	"	14.	21	00
By S. J. Hayes	"	15.	20	00
By balance on hand			58	65
Total			$1,470	00

Respectfully submitted,
S. J. HAYES, Treasurer.

H. M. BRITTON,
JAMES SEDGELY,
MORRIS SELLERS.

On motion, it was voted that it be received and placed on file.

THE PRESIDENT—Before proceeding with the reports of committees, there is some correspondence that I would recommend that the Convention hear read and act upon; and some perhaps which it would be well to refer to the Committee on Correspondence. A letter has been received from the Secretary of the Superintendents' Association of this city which, perhaps, it would be well to have some action taken upon, some committee appointed, or otherwise, as the Convention sees fit, before we proceed to other business. If the Convention sees fit, we will have it read.

The Secretary read the communication, and on motion of Mr. Wells, of the Jeffersonville, Madison & Indianapolis Railroad, it was voted that it be received and a vote of thanks be tendered to the parties for their kindness.

THE PRESIDENT.—There have been several letters received from different individuals extending invitations, etc. Is it your pleasure that they be read or referred to a Committee on Correspondence.

On motion of Mr. Hayes, of the Illinois Central Railroad, it was voted that they be referred to a Committee on Correspondence; also that such committee consist of five members, to be appointed by the Chair.

The President announced the committee as follows: Messrs. Hayes, of the Illinois Central Railroad; Robinson, of the Great Western Railway; Hill, of the Erie Railway; Ham, of the New York Central Railroad, and De Clercq, of the Toledo, Peoria & Warsaw Railway.

THE PRESIDENT.—The next business in order will be the report of your Committee on Boilers and Boiler Materials, consisting of Messrs. Hayes, Illinois Central Railroad; Jauriet, Chicago, Burlington & Quincy Railroad, and Lamb, Des Moines Valley Railroad.

The report was read, and, on motion of Mr. Sellers, late of the Des Moines Valley Railroad, it was voted that it be received and the committee discharged.

REPORT ON BOILERS AND BOILER MATERIALS.

To the American Railway Master Mechanics' Association:

GENTLEMEN: Your Committee on Boilers and Boiler Materials beg leave to submit the following report:

Copies of the following questions were sent to the various master mechanics, and twenty-four answers were received:

1st. Is the present form of locomotive furnace the proper one for the economical consumption of coal, or can you suggest a different and better form?

2d. Please give your views of the comparative merits of the plain furnace, as compared with that having the fire-brick arch or water-table.

3d. What in your opinion are the comparative merits of straight and wagon-top boilers for locomotives; of boilers with one, compared with those having two domes; of taking steam in the dome or domes, compared with the use of a perforated dry-pipe? Please state your preferences with your reasons therefor.

4th. What diameter of flues do you advise for use in wood and coal-burning engines?

5th. Have you ever experimented, with a view to burning bituminous coal, with a draft from the top of the fire downwards? If you have, please state the results.

6th. Do you know of an American iron for furnace sheets as free from lamination and liability to blister as the Low Moor iron? If yes, please state the brand and the length of service of the sheets.

7th. Have you experimented with a view to determining the relative strength of drilled and punched boiler plate in the rivet seam?

8th. Do you advise drilling instead of punching the rivet holes in boiler plate?

9th. Do you think the use of a drift materially lessens the strength of boilers in the rivet seams?

10th. Please state the material and thickness of the thinnest front and back flue sheets you have used with safety in boilers of coal-burning locomotives?

11th. Can you suggest any advantageous changes in material or the construction of locomotive boilers?

12th. For the benefit of the Convention, please communicate any facts or information you have of interest, pertaining to the subject upon which this committee is required to report.

In reply to the first and second questions, various opinions are expressed. The large majority are in favor of the plain box for wood or coal-burning engines. The reasons assigned are that water tables and brick arches are expensive, and show no economy in fuel used. Your committee have made no new experiments, and can only present you with the views of a few gentlemen, some in favor of plain furnaces, others in favor of the arch or water table for coal-burning engines.

Mr. H. A. Towne, of the Hannibal & St. Joseph Railroad, gives results of experiments running through eight months with engines having plain furnaces, and also the results obtained from the same engines during eight months' service with the water table.

The average miles per ton of coal with the plain box is stated at 24.9, and the average with the water table 40.29 miles, a difference of 61 per cent. in favor of the water table.

Mr. Ham, of the New York Central Railroad, states that he has experimented with the plain box, as compared with the brick arch and the water table, and finds a saving of 8 per cent. from the use of the arch, and 12 per cent. from the use of the water table.

Mr. Van Vechten, of the Atlantic & Great Western Railroad, states that in his experience "the first cost of the plain box is less; it is easier kept in repair, and affords greater economy in fuel" than a box having the arch or watertable.

Mr. Setchel, of the Little Miami Railroad, is of the opinion thas the plain box will give the most satisfaction, all things being considered. He states it as his belief that more fuel can be saved "by a judicious system of firing, than by any device that has yet been instituted for the consumption of smoke." He says further, and we quote from his letter, "the truth of the matter is this: two-thirds of the locomotives burning coal really burn more than they should for the reason that the locomotive attendants are not particularly interested in the amount of fuel saved, and do not give the matter the attention it deserves, and hence it is that any man who has had practice, and who has given the subject a sufficient amount of study to get up a plausible theory for a successful furnace, almost invariably succeeds in making a show of a saving of coal, simply by giving close attention to the firing, when perhaps, with the same attention given to the plain box, the result would be equally satisfactory."

Mr. Wells, of the Jeffersonville, Madison & Indianapolis Railroad, prefers the plain box, but advises an increase in size over that now in use on our standard engines. In his opinon the furnace should be longer and deeper, the grate area being the same as now, and, as a consequence, the steaming capacity of the boiler greater, so that the gases need not be "hurried" through the flues as is now done, but more time be allowed for combustion. He expresses the conviction that "boilers of coal-burners are, as a class, too small," and therefore do not burn coal economically.

Your Committee cannot suggest any desirable changes in existing forms of locomotive furnaces. They see the necessity for better combustion and greater economy in the use of fuel in furnaces of coal-burning engines than can be obtained with any known device.

Your attention is invited to the suggestive words of Mr. Setchel and to the views of other master mechanics as herein submitted. From their own individual experience in past years, your Committee recommend the use of the fire-brick arch, or water-table, in furnaces of all passenger locomotives burning bituminous coal; leaving out the question of economy in the use of fuel, we are of the opinion that either of these appliances lessens the volume of smoke and cinders thrown from the stack and contributes to the comfort of the traveling public.

Your Committee also recommend the admission of air above the fire through suitable openings arranged for that purpose. Passenger engines with furnaces arranged as specified run cleaner than those with a plain box and no air openings, they steam as freely and it is highly probable that they effect a saving in the consumption of bituminous coal.

Your Committee recommend the wagon-top, in preference to the straight boiler, for locomotives, especially where impure water is used. It affords greater steam-room, larger water-surface over the furnace, and decreases the liability to foam where the water is bad. It is easy of access, when the mud and scale must be removed from the crown-sheet, or when repairs are necessary to the numerous braces over the furnace, and, as stated by Mr. Wells, of the Jeffersonville, Madison & Indianapolis Railroad, it distributes the weight to greater advantage upon eight-wheeled engine with four drivers than does the straight boiler. The cylinder part can be smaller in diameter, and consequently lighter, than with the straight boiler, thereby lessening the weight upon the truck; while the furnace-end will have greater weight, due to the wagon-top, and will give proportionately more adhesion to the driving-wheels. The straight boiler can be built at less cost than the wagon-top, and is subject to fewer unequal strains; but your Committee think the advantages of the latter form more than compensates for the defects. Two domes are preferable to one on boilers with limited steam-space, and on boilers using impure water, providing steam is taken from both domes. Lesser variations in water-level and dryer steam in the cylinders are obtained.

Where the water is pure, or the boiler capacity large in proportion to power of engine, one dome is sufficient.

Very few speak favorably of the perforated "dry-pipe" for locomotive boilers.

Your Committee recommend two-inch flues for wood and coal-burning locomotive boilers. In regard to burning bituminous coal with a draft from the top of the fire downward, we report that experiments do not warrant a conclusion favorable to the idea.

Mr. Van Vechten, of the Atlantic & Great Western Railroad, reports that he has tried the experiment, but the results were unsatisfactory. Mr. Robinson, of the Great Western Railway of Canada, writes as follows: "I have found highly satisfactory results in coal-burning in ordinary fire-boxes, by using what is known as a removable deflecting plate bent about half-round and inserted through the fire-hole, hollow side downward, dipping toward the center of the fire (the fire-door being left open when this is used), thus producing a downward draft of air upon the fire. The best results, however, I think were obtained by a current of air admitted immediately under the brick arch, which was directed downward by the inclination of the arch toward the center of the fire."

One of your Committee experimented with a watertable secured to the back sheet of the furnace, over the door, and projected downward toward the center of the fire; the furnace door was arranged so as to admit of its being opened partly or fully, as occasion required; air was admitted continually through the opening and carried down by the table; a fire-brick arch was arranged in the front end of the furnace, to throw the gasses back and compel their mixture with the air admitted as described above. The experiment was not successful. The volume of smoke was lessened materially, and the engine steamed fairly in warm weather, but in winter it was impossible to generate sufficient steam to enable her to perform her regular freight service.

Your Committee cannot recommend an American iron, for furnaces sheet, as free from lamination and liability to blister as Low Moor and kindred brands of English iron.

A large majority of master mechanics from whom we have heard advise drilling instead of punching rivet holes in boiler plate. No tests of their relative strengths were reported, and your Committee, therefore, felt compelled to experiment in order that definite information might be given you.

The following tests were made, all the pieces being from the same sheet:

Three pieces of 5-16 in. boiler plate, 1¾ in. wide, were torn in two by hydraulic pressure.

No. 1	broke under a strain of	32,228 lbs.
No. 2	" "	32,228 "
No. 3	" "	33,600 "
	The average breaking strain being	32,685 "

Three pieces of 5-16x1¾ in. plate were *punched*, one ¾in. hole being put in each piece. They were then subjected to a tensile strain, with the foillowing result:

No. 1	broke under a pressure of	13,371 lbs.
No. 2	" "	13,371 "
No. 3	" "	13,714 "
	The average being	13,485 "

Three pieces of 5-16x1¾in. plate were *drilled*, one ¾in. hole being put in each piece.

No. 1	broke under a pressure of	17,828 lbs.
No. 2	" "	17,485 "
No. 3	" "	17,622 "
	The average being	17,645 "

The average strength of the drilled plate being 4,160 lbs. greater than that of the punched plate.

Great care was taken to dress the pieces to the sizes given after they were punched or drilled.

The following comparative tests were then made with punched and drilled plates riveted:

Six pieces 1¾in. wide, and cut from the same sheet as the foregoing, were punched and riveted together, in pairs, with the best ¾in. rivets, one rivet to each pair, and were subjected to a tensile strain, with the following result:

No. 1	broke in center line of hole under	17,828 lbs.
No. 2	" " " "	17,828 "
No. 3	" " " "	17,143 "
	The average breaking strain being	17,599 "

Six pieces, duplicates of those last mentioned, were *drilled* and riveted together in pairs, one ¾in. rivet to each pair.

No. 1	sheared the rivet under a pressure of	17,143 lbs.
No. 2	" " " "	16,457 "
No. 3	" " " "	15,428 "
	The average shearing strain being	16,342 "

You will observe that the rivets securing the plates having drilled holes were sheared under a less pressure than was required to tear asunder the plates having punched holes.

It is also worthy of note that while the punched plate is weaker than the drilled plate, the rivets in the punched holes do not shear so easily as those in the drilled holes. This is probably due to the edges of the drilled holes being sharper and more compact, and consequently more capable of shearing than the edges left by a punch. It is not probable that the tensile strength of boiler plate, per square inch of section, is impaired by drilling, but your Committee are satisfied it is impaired by the use of a punch.

In view of these facts, we advise drilling the rivet holes for longitudinal seams of boilers; the circular seams are not subject to so great a strain and may be punched. We also advise the use of ¾in. rivets, 1¾in. from center to center, for all seams in locomotive boilers made of ⅞in. iron, as the ¾in. rivet is too small to resist a shearing strain equal to the tensile strength of the plate between the rivet holes when they are drilled.

We are of the opinion that a drift should not be used in the rivet holes of any boiler; if the holes do not correspond, a reamer should be used.

We think back flue sheets should be ½in. thick if of iron, and ⅜in. thick if of steel; front flue sheets ⅜in. thick if of iron and ½in. thick if of steel.

In the various communications received from master mechanics, no changes of importance were suggested in the material or construction of locomotive boilers.

Your Committee have one recommendation to make, and that is in regard to stay bolts for locomotive furnaces. We strongly urge the advisability of using hollow stay-bolt iron exclusively, so that if a stay-bolt breaks partially or entirely, it will be discovered immediately.

The objection may be made that too much cold air will be admitted in the furnace. This, however, can be readily avoided by driving suitable plugs into the inner end of the holes in the stay-bolts. A boiler recently examined was found to have 40 broken stay-bolts. The boiler is 2½ years old, and is stayed with ¾in. bolts, 4½in. from center to center. Another boiler was found to have 15 stay-bolts broken.

Similar instances are numerous, and we think safety demands some surer way of detecting broken stay-bolts than that of getting in the furnace and sounding with a hammer. An examination of this kind is rarely made unless an engine is in the shop for repairs; and consequently boilers often run in an unsafe condition, on account of hidden defects of this character.

The remedy we suggest is thoroughly reliable. In order that you might have definite information of the strength of ¾ in. hollow stay-bolt iron, your Committee tested the tensile strength of three pieces.

The hole through the center was ½ in. diameter, and the sectional area of the metal .175 of a square inch.

No. 1	broke under pressure of	28,457 lbs.
No. 2	" "	29,828 "
No. 3	" "	30,171 "
	The average being	29,485 "

By experiments made a year ago, and submitted to this Association, we found that ¾ in. stay-bolts tapped into ⅞ in. plate, and riveted over, pulled out under an average pressure of 21,486 pounds, which is 8,000 pounds less than the tensile strength of ¾ in. hollow stay-bolt iron.

It is certain therefore that the strength of ¾ inch hollow stay-bolts is more than sufficient to resist the strains to which they will be subjected, if placed 4½ in. from center to center.

We submit herewith a drawing of a boiler complete, as built by Mr. W. A. Robinson, of the Great Western Railway of Canada.

Respectfully yours,

S. J. HAYES, Supt. Machy. I. C. R. R.
C. F. JAURIET, Supt. of Machy. C. B. & Q. R. R.
J. LAMB, M. M. D. M. V. R. R.
} *Committee.*

Mr. HAYES, of the Illinois Central Railroad.—Before proceeding with the discussion of the report, the Committee on Correspondence are ready to report on those communications which have been handed to them. Mr. Robinson, the Secretary, will read the report.

Mr. ROBINSON, Great Western Railway, read the report, as follows:

REPORT OF COMMITTEE ON CORRESPONDENCE.

Correspondence submitted consisted of one invitation only, beyond what had already been considered by the Committee on Invitat on, this one being from the Waltham Watch Company, and received too late for the necessary arrangements. It was resolved that this firm be thanked for their consideration and proposition, but that the same be respectfully declined for the reasons mentioned.

The other invitations, which have had the consideration of the Invitation and Reception Committee, it was resolved be accepted in the order presented.

Recommended that all members who intend availing themselves of the New Hampshire excursion, will give in the names to the Secretary of the Association on or before 2 o'clock tomorrow.

S. J. HAYES,
E. O. HILL,
C. T. HAM,
A. H. DE CLERCQ,
W. A. ROBINSON,
} *Committee.*

On motion of Mr. Keeler, Flint & Pere Marquette Railroad, it was voted that it be received and the recommendations adopted.

DISCUSSION ON BOILERS AND BOILER MATERIALS.

THE PRESIDENT.—The discussion of the report on Boilers and Boiler Materials, just read, is now in order.

Mr. HAYES, Illinois Central Railroad.—I was not present when that report was read, but of course I am familiar with its import, and I would like to hear an expression of the master mechanics present upon the subject. Your committee have taken considerable pains to get at a practical report. It is true there is very little of theoretical opinions in it; nearly all of it is practical. In regard to the pulling of the iron in two, showing the difference in strength of iron between drilled sheets and punched sheets, we have taken considerable pains and considerable trouble; also in riveting sheets together to compare the strength of a single-riveted seam and a double-riveted seam, and I should like to hear the opinions of those who were present to hear the report read. I am satisfied it would be entertaining to the Association, and we should profit very much by a discussion on the subject.

Mr. HUDSON, of the Rogers Locomotive Works.—I would like to ask the Committee a question in regard to these plates that were punched and drilled, and that is, whether the grain of the sheets was all in the same direction. It is well known that the strength of boiler plate differs very much, whether with the grain or across the grain. I merely wish to ask the Committee if these sheets were all taken with the grain in the same direction. If so, then the tests are comparative and are of value; but if taken without regard to the direction of the grain, I apprehend it throws serious doubt, or would throw serious doubt, upon the reliability of those experiments.

Mr. HAYES, of Illinois Central Railroad.—Your Committee was well aware that iron does not always present the same strength taken from the same sheet unless pulled in the same direction. They were perfectly well aware of that, and hence all of these pieces that the experiments were made with were taken from the same sheet and taken as the sheet was rolled, longitudinally, not crosswise. They were aware that a sheet pulled crosswise will not stand as much as when pulled lengthwise, and hence the Committee was very particular to have the strain longitudinal. The experiments were all made with a view of showing a fair test, and not to show that one iron was better than any other. We cut it all from the same sheet, so as to make the experiments a fair test. In the first experiment with the drilled sheets—the first three pieces—we found, when we pulled them in two, that it sheared the rivets; it didn't pull the iron in two, but sheared the rivets; hence we found where sheets are drilled it is necessary that the rivets should be made larger; in every case where the rivets were the same size and where the sheets were punched, the sheets pulled in two and the rivets were not sheared. We found the same in steel in our former report. We found in our former report also that steel varied but very little whether it was pulled crosswise or lengthwise, and we found ten or fifteen per cent. difference in iron, whether *it* was pulled crosswise or lengthwise.

THE SECRETARY.—I would like to ask Mr. Hayes, as the Committee have recommended increasing the size from ¾ to ¾ in order to stand the tensile strain of the iron in drilled sheets, if it would not increase the strength in the same proportion if the sheets were punched, and if, in the end, we would not get a greater tensile strength to the iron by the punched sheets than by the drilled sheets by using the increased size of rivets.

Mr. HAYES, of the Illinois Central Railroad—We certainly would not get the same strength, because there is a positive proof that the drilled sheet does stand more tensile strain than the punched one, and hence all you have to do is to put your rivets farther apart and of an increased size, and you get the increased strength between a punched and a drilled sheet. I think that will answer the question.

THE SECRETARY—I did not understand the Committee to recommend putting them any further apart.

Mr. HAYES, of the Illinois Central Railroad—Certainly; farther apart and larger rivets.

Mr. HUDSON, of the Rogers Locomotive Works—There is another question involved in this matter of punched and drilled sheets, which it might be well to understand in order to arrive at a correct conclusion. It is well known that the strain in punching a sheet depends very much upon the size of the die as compared with the size of the punch. If the punch and die are of the same size precisely, the sheet is strained very much more in being punched than it is where the die is slightly larger than the punch. In that case you make a conical hole. Again, in riveting sheets so punched it is important to know which side of the sheets are put together—whether you put the two large sides of the holes together. If you do, you get a larger section of the rivet when it is driven and sheared apart, and possibly if they were put together in that way, there might be a larger section, and that might account for the rivets not being shorn apart in the punched plates when they might be, with the same size, if they were put the other side to.

pMr. HAYES, Illinois Central Railroad—Those sheets that were unched were punched with a keen, sharp punch, and hence there was but very little difference between the upper side of the hole and the under side; and in putting them together we were not particular whether it was the upper side or the under side of the hole. But we all know, in the force required to send a punch through a 5-16 sheet of iron you must start more or less of the fibre of the iron some distance out from the hole, and hence it must weaken that hole. If you take the two upper sides of the hole, which are invariably a little larger than the two under sides, and put the rivets in the other way, I believe the sheet would stand a little more than the other way; but, at the same time, where sheets are punched with a good sharp punch, and a die that fits the punch, you must get a pretty true hole, and it must show a pretty true conclusion of the strength of that material. If you take a microscope, you will find, when a sheet is punched, there are little lines all around that hole, where the fibre of that iron has been started, and hence that iron must be weaker. These pieces we punched were of a certain width; we punched a hole straight through the metal, and then took a planer and planed them out so as to get precisely the same size on each side of the hole to the outer edge of the metal. We were very careful to get that correct, and then we took hold of the two ends and pulled it in two. If you get one side a little narrower than the other side, that would give way first, and it would not show a fair comparison of the strength of the metal; but when we were careful to get the exact size on both sides, I think we got a conclusion pretty correct, and I am satisfied—it showed very conclusively to my mind—there was a great difference between the punched sheet and the drilled sheet, and hence we recommend that where the strain comes greatest upon the boilers, the sheets be drilled. In the other parts than longitudinal parts, where the strain is not so great, punched sheets will answer every purpose.

MR. HUDSON, Rogers Locomotive Works—I don't know that I made myself understood entirely in regard to that question of punched sheets. I wished to state that it is a fact that sheets are deteriorated in punching to a very much greater extent where the punch and die are pretty accurately of a size than where the die is largest. I know that to be the fact, and therefore I say it is important to understand it. Mr. Hayes, I think, has clearly stated that the punch and die were very nearly of a size. I stated that in that case the punching deteriorates the iron to a much greater extent than it would if the die was a little larger. Then again, in punching sheets they wear the punches too long; in other words, they become taper, and after entering the drift at the base they enlarge the hole. That is what injures punched sheets, in my estimation. I am certain that, with the tools kept in perfect order, and with careful attention paid to the size of the die, the deterioration in punching over that in drilling is not as great as is generally supposed.

MR. WELLS, Jefferson, Madison & Indianapolis Railroad—I presume that the effect of a punch in a rivet hole in a piece of boiler plate, either of iron or steel, is precisely that of a punch in a nut, and we all know that cold punched nuts, when tapped, seldom show a perfect thread. You must have the hole the same size that the drilled hole is, and when you come to cut out a portion of that metal with the thread of the tap, the remainder will show a ragged and broken edge, and wherever it presents that appearance it is evident that the metal is not perfectly solid. It looks to me reasonable that a punch, under the best of circumstances, will to a certain extent depreciate the strength of the metal—the metal immediately around the hole. The particles are driven down, and there is a sort of a wedging process brought to bear upon that metal immediately around the hole, and that, together with the strain that is upon the iron, brought by the pressure—the tensile strain—will necessarily break it sooner than if the metal is left entirely free from strain when the rivet is put in. I don't think it makes much difference with the holes in the seams running round the boiler, whether they are punched or drilled, because there is sufficient strength, under ordinary circumstances, with a punched hole with the poorest punch. The longitudinal seams of the boiler should be left in the strongest possible condition, and in order to get at that I don't think there is any way so good as to drill those holes.

Mr. ELLIOTT, Ohio & Mississippi Railroad.—I think the report of the committee was that they find no American brand of iron to compare with the Low Moor for locomotive boilers. I would state that in my experience there is at least one brand of American iron which I consider equal to the Low Moor iron—the Sligo iron. I have used it for some years, and I think for all locomotive iron, it proves fully equal to the Low Moor. I do not include fire-boxes. I think we must all have realized before this time that steel is so much better than any brand of iron for fire-boxes that it is hardly worth while to take time to consider the use of iron for that purpose; but for the shell and flange I find the Sligo iron equal to the Low Moor.

MR. HAYES, of the Illinois Central Railroad.—It the Secretary will be kind enough to read the question here that was propounded to the master mechanics, it will show what the intention of that question was in regard to the use of Low Moor iron.

The Secretary read, "Do you know of an American iron for furnace sheets as free from lamination and blister as Low Moor iron? If yes, state the brand and the length of service of the sheets."

MR. HAYES, Illinois Central Railroad.—If Mr. Elliott will notice he will see that the inquiry was propounded as to furnace-iron, not for the outside shell. There is no lamination at all on the outside shell. It is the blistering, etc., on the flue-sheets and sides of the furnace. We find out West, where the water is very bad, and such scale as this (one of the samples exhibited at the meeting) is formed on the crown-sheets—we find it impossible to use steel for the crown-sheets. The steel becomes hardened, and that formation is formed on the top of the crown-sheets, and the water is kept away from it and the crown-sheet bulges downwards, and when we go to straighten it up we find the crown-sheets crack; hence we have been using Low Moor and other soft iron. That was the object of that question. I am satisfied when you come to the shell of the boiler that Sligo iron will beat Low Moor; but it will not, in my experience, either for crown-sheets or for furnace sheets. In every case that I have used it, I have found that the sheets were not solid. After a while they blister; and sometimes in drilling them, I have had the flue-sheets come out in two washers. It is a series of layers of iron put into a furnace and heated and hammered and run through the rollers, and some of the layers do not get firmly welded, so that when we have drilled them they would come out in washers. When I used them in furnaces, the side on which the water was would be contracted, and the side on which the fire was would bulge out, and be chipped off; and hence the flue-sheet was only half the thickness it ought to be. That is the case with all American iron I have seen; but in steel, that being cast and then hammered, there are no seams at all, and hence you do not find any seams at all in the steel sheets; but for crown-sheets and for flue-sheets I have always found that trouble with American iron, and some of it with English iron, but less with the Low Moor than any other brand.

MR. PHILBRICK, Leavenworth, Lawrence & Galveston Railroad.—There is one little point, slightly touched upon by the gentleman, about the shearing of the rivet. The idea that there was more iron in these was clearly brought out; but the idea that the rivet sheared in the drilled sheet, because the corner was square, seemed to be given as an objection; the statement was that it sheared easier because the corner was square. We can correct that by rounding the corner a little; but from what the gentleman says in regard to punching, I think there may be a question as to that—a question as to the correctness of that reasoning. He says it punches easier if the die is larger, making the punch come down not directly square across and punching it, but by giving it a chance to bend a little and carrying the particles through easier. If you say that it shears so easy because they are so close together, you have started another system of shearing, which, I think, in good iron, we have pretty well established is not true. I think you can take off a large bolt; you are more liable to take it off when the particles are a little apart than when they are close together. I don't think you can round your hole and drive a rivet that shall fill that corner. I think the reason the rivet sheared easier was because there was more iron in there, which was true. The reason it sheared easier in the drilled hole was because it was smaller. In the punched hole you have more iron to cut off. I don't think the square corner is quite the reason it shears so easy.

MR. MAYNES, Selma, Rome & Dalton Railroad.—I cannot agree with Mr. Hayes in regard to Sligo iron. I have had experience with that iron. I had charge of building two boilers made entirely from that iron, in which we drilled all the holes. I superintended the drilling of the flue-sheets, and I found no disposition of the iron to make washers that he speaks of. I don't think there was a hole in it that came out in that way. I think it equals the best. I think we owe it to our home manufacturers to stand by them where they make good iron like the Sligo iron.

MR. HUDSON, of the Rogers Locomotive Works.—This question of iron and of the comparative value of American as compared with Low Moor and other irons, I think is very important. My experience with Low Moor iron is like this: that while Low Moor iron is well manufactured, it is free from lamination and will stand fire, at the same time it is tender. You have got to be careful in working it, in flanging it; otherwise it will break on your hands. Also in riveting it; if you have to bend it a little, you must warm it, otherwise you are liable to crack it. I think I can safely say that there is a brand of American iron, and possibly more than one—at least I can speak of one—which, so far as we have used it, and we have used a good deal of it, is equal to any Low Moor iron and is free from lamination, and so far as its tensile strength and ability to stand hardship in flanging and planing and twisting in every direction is concerned, will stand a great deal more, and that is the iron made by Bailey, of Douglasville, Pa. I am not afraid to brag upon his iron, and I think it is a matter of justice, and justice to American iron, to say there is a brand of American iron which is in all respects in standing fire equal to the Low Moor, and in other respects far superior, as having more tensile strength.

MR. HAYES, Illinois Central Railroad—I don't wish to have it understood that I came here with a view of advocating English iron or any other brand of iron. I am an American, dyed in the wool, and therefore if we have got an American iron that will beat our foreign irons, let us have it. That is what we came here for. We came to discuss these matters, and if any gentleman knows of any better iron I am the one to adopt it to-morrow. I would like to hear from all these gentlemen and get their experience, and that was the object of that circular—to find out whether we could get an iron that was equal to the English iron. If we can, I say let us adopt it, and use it throughout the country.

MR. GORMAN, Toledo, Wabash & Western Railway—The question of iron seems to be on the tapis now. There is another brand of iron I have been using for the last six years. I don't know whether it has come generally into use in the East or not. It is the Tennessee charcoal iron, and I must say I prefer it decidedly for boiler shells. We don't use any iron in the furnaces. I have used the Tennessee iron and I have never had one bad sheet, never have been able to find one that had any tendency to blister, or have any seams through it. I have a very good boiler-maker, who has been previously in favor of Sligo and Low Moor iron; in the last years he says he don't want to use anything better than the Tennessee iron.

MR. FLYNN, Western & Atlantic Railroad—I will corroborate what the gentleman says. My supposition is this, that, so far, the Tennessee iron has never had the opportunity which most of the irons in the United States have had to have the justice which it ought to have. I myself am of the opinion that it is equal to Low Moor iron. I have used it, and I have used the Low Moor iron and the Sligo iron likewise; and I must say, without prejudice, that I think the Tennessee charcoal iron is equal to any iron used in this country. I hope the master mechanics, if they have an opportunity, will give that iron a test. It is manufactured in Tennessee, and the principal office, I think, is in Louisville. By using it we might be able to demonstrate, by our next annual meeting, whether it is not equal to any iron we have.

MR. ELLIOTT, Ohio & Mississippi Railroad—I have used that Tennessee iron myself, in connection with Sligo, and I think it is fully equal to Sligo. I would like to make a remark in regard to Mr. Hayes' idea of using iron for crown-sheets and flue-sheets in preference to steel. That is not my idea. I prefer steel for crown-sheets, and any other place where there is a tendency to deposit any foreign substances. We want something that is homogeneous and will not split and blister. I have been using steel crown-sheets, and we have very muddy water. I had one case where, from a deficiency of water—which all locomotive engineers understand—the engine was what we call "burned." The crown-sheet came down and formed nearly all over the sheets in dishes between the stay bolts as much as ¾ of an inch, and the sheet was taken out and the dish straightened out, annealed and put back in the fire-box, and has run since that time, three years, and shows no signs of defects. The engine was a Grant engine, built in 1868.

MR. GRANT, Rockford, Rock Island & St. Louis Railroad—I should like to know the brand of steel of which he speaks.

MR. ELLIOTT, Ohio & Mississippi Railroad—I am not able to state the brand of steel that I spoke of particularly in this way. It was an engine built by the Grant Locomotive Works. I have had no trouble with it whatever.

MR. GRANT, Rockford, Rock Island & St. Louis Railroad—I think it is important that the brand of iron or steel sho ild be given, not as an advertising medium, but that we may know the brand and know where to purchase a peculiar quality.

MR. HAYES, of the Illinois Central Railroad—In regard to the use of steel in flue-sheets, we have used the brand of Hussy, Wells & Co. and Park Bros., and after running from four to eight or ten months, we find when this lime deposit becomes very thick on the crown-sheets they bulge down between the stay-bolts. We find it necessary to take off the crown bars to get that deposit off. When we do that we build a charcoal fire, leaving the crown-sheet in its place, and force it up into its proper place. In doing that, with steel sheets, we find in almost every case that they crack where the crown-bars went through the holes, but not when we have Low Moor or other good brands of iron. Sligo Iron, if it did not laminate, is as good as Low Moor; but it is more liable to laminate and separate between the seams. There is one other brand of steel, (almost all we have used has been the Hussey, Wells & Co.,) Park Brothers' black diamond steel, but we found on straightening that up, after they bulged down, (and they will do it, when you get a large amount of deposit and the water is kept away from the sheet, it must become heated and bulge down,) that it would crack between the bolt holes. If it didn't do that, I would rather use the steel. I am using steel for side sheets and back sheets of furnaces, but in the flue-sheets I find that steel becomes hardened after using it a while, and they are more liable to break. When you have good water, I should say use steel throughout in the whole furnace, and nothing else. Some of our Western roads have had to abandon steel, and have gone back to copper. I think that the Chicago, Burlington & Quincy Railroad has gone back to copper entirely. I use steel, except for flue crown sheets.

MR. HUDSON, of the Rogers Locomotive Works—I should like to make a few remarks in regard to working steel and iron sheets for furnaces. Perhaps, it is hardly in order, but I think it would be a matter of interest. We find that in all sheets that require flanging, the tendency is to warp and distort the sheets, and crook them all up, while in that condition we find it neccessary to heat them uniformly all over, heat them in a furnace, and then to let them cool, and the durability of furnace sheets is very much enhanced when treated in that manner. I know that many railroad shops, for want of the proper facilities, are in the habit of flanging their sheets and keeping them straight, in other words, putting the strain of the difference in the length, all into the sheet. The tendency is, it only watches for the first opportunity, and it cracks. Then it is said to be the fault of the sheet, whereas the sheet was not so much at fault as the mode of working it. The subject is one that is of vital importance—the durability of sheets in furnaces, whether of iron or steel.

MR. ELLIOTT, Ohio & Mississippi Railroad—I agree with Mr. Hayes that iron is preferable for crown-sheets, if that is the treatment he proposes to put them to. I don't see any reason for such treatment of crown-sheets. We have such things happen, but we have it much more seldom with steel than iron; but if they crook and have to be straightened, iron would stand it better. The sheet I spoke of I took out entirely, but it held out so well it didn't show any bad effects. To attempt to straighten a crown sheet, even of iron (I have done such things), is the greatest risk. The chance is you will produce a crack before you get the sheet straight. Sometimes you have to do it, but I think Mr. Hayes will agree with me that the accumulation of such an amount of material on the top would only occur once in a great while. If it was a common occurrence, there should be some means of cleansing the crown-sheet.

MR. EDDY, Boston & Albany Railroad—I recollect, in attending our convention some two years ago, that the master mechanics then were pretty much all steel. My friend Hayes thought, if I recollect right—at any rate, I gathered it from what he said—that there was nothing else fit to put in a furnace in any shape but steel. I see he is creeping back a little; not creeping, perhaps, but walking upright, and he is coming round by degrees where I think all roads that have a heavy traffic will soon be—that they will not use any steel for fire-boxes on their roads. I have had considerable experience that way, and I am decidedly opposed to using steel in fire-boxes, in any way or shape.

MR. SEDGELEY, Lake Shore & Michigan Southern Railway—I wish to say a word in regard to my experience. Up to six or seven years ago, upon the Lake Shore and the Michigan Southern & Northern Indiana roads, we had been using for crown-sheets and flue-sheets, almost exclusively, different brands of iron. Upon some portions of our road we suffered severely from bad water, from an excessive accumulation on our crown-sheets and tubes. I found that even by the use of the best of iron, Low Moor, Sligo, Pennock and others—all the different brands I knew of—it was almost impossible to make a crown-sheet stand over three years, with the very best attention you could give it. The same was true of the tube-sheets. At that time, or previous to that time, we had imported perhaps a dozen steel sheets from the Canada companies' works, which were put in, and I think, without an exception, the tube-sheets are whole to-day, and of the crown-sheets that were put in not one has been removed or required patching. So far as my experience goes, I believe that one steel sheet for a crown-sheet is worth two iron ones of the best quality I have seen. As the Committee on Boilers referred to tube-sheets, I would like to ask the gentleman's objection to steel for that purpose. It is a matter that I am interested in. My experience, although limited, perhaps, to what some of the other gentlemen have had, leads me to believe that steel is far preferable to iron.

MR. ELLIOTT, of the Ohio & Mississippi Railroad—I was just going to ask Mr. Eddy what brand of steel he had had his experience with. Another thing we must take in connection with it. We must take into consideration the fact that the manufacture of steel only dates back a very short period, and some may come to a wrong conclusion from having unfortunately got into their hands a poor brand of steel. I think what is said here ought to have some weight to lead a man to think whether he has not. When I state that I have never had a sheet, in building 20 boilers—never had a steel sheet fail, certainly it goes a long way in establishing steel for that purpose. Mr. Eddy may have had a poor brand of steel.

MR. EDDY, of the Boston & Albany Railroad—My experience has been almost altogether with Hussey, Wells & Co.'s brand of steel—scarcely anything else. We had occasion to take a part of a sheet out of a boiler not long since, and I found I could take a common hand hammer and knock the sheet where it was flanged and it would fly like glass—steel that they claimed was the best steel they could make, and was the best in the market to put into engines. The engines were built at the Grant Locomotive Works, I know, and the work was well done, and the material was said to be the best. That was the character of that steel. It cracked from the holes out very badly, and it was very brittle. As I said before, you could take a hammer and knock it to pieces like glass. I meant to have brought a specimen here, and remarked to a gentleman since I have been here that I was sorry I had not brought it. You can take a common hand hammer and knock the flange off.

Mr. ————I should like to ask the gentleman if he knows whether that steel was punched or drilled? I think that is a vital point for us to know; also whether that steel was of the requisite character. I do not intend that a piece of steel shall be used in a furnace that will harden by heat. I don't believe a sheet should be put in that you can harden.

MR. EDDY, Boston & Albany Railroad—The steel would not harden. I tried it, but could not harden it. The Grant Locomotive Works built four engines for the Boston & Albany Railroad. They built them as sample engines, and agreed to—and, so far as my knowledge goes, did—put in the best material and workmanship, or as good as any engines we ever had, and they put that steel in because they thought it to be the best thing that could be obtained. I have had other experience besides that just as conclusive to me. I don't know that I can go the ground over in all its minute details, but suffice it to say that my experience has been very bad with steel fire-boxes, and I have had very bad luck with it, if there was any luck in it—so bad luck that, if left to my own inclination, I should not put in any more unless I saw a great change in steel. I am not here to advocate or to please any man or any set of men. We come here for information: we don't come here to bolster up this thing or that thing, nor this material nor that material: simply to tell, without fear or favor, our opinions, and to consult together as to the best thing for our railroads, and to get at the best thing in the market.

MR. GREGG, of the Erie Railway.—It has occurred to me that the drift of this discussion has taken a different direction from what it did when it first commenced here. If I understood Mr. Hayes, he was not discussing the question as to whether steel was better than iron for fire-boxes, or iron better than steel, *in general*; but only that iron was a better material for him to use (where he had bad water) than steel, simply from the accumulation that collected on top of the fire-box; he preferred iron to steel on that account simply, not because steel was *generally* a poorer or an inferior article to use than iron, but because it was a better material to use where there were great accumulations on the top of fire-boxes. Perhaps he is right there. On that I cannot tell, because I have never had any experience in that direction at all. The water, wherever I have

had any experience at all, has generally been good, and the accumulation in the boiler very little indeed. We have never been bothered in that direction. There has been some discussion here as to whether iron is not better than steel, and whether steel is not better than iron. Our friend Eddy says he prefers iron, and seems to think that Mr. Hayes is going back gradually, commencing with the crown-sheet, and will after a while get to the sides, and the whole thing will be of iron. My experience with fire-boxes has been in favor of the use of steel; for a long series of years my experience was with the Bowling iron, the English Bowling iron, and I presume a large number of the master mechanics here to-day have used the Bowling tires that were imported years ago. Perhaps very few of them are imported now, but the Bowling and Low Moor tires were very generally imported and generally used. Both were used on the Erie road twenty-five and thirty years ago, and down since that time to within ten years ago, we used many of them. I have some of them now in use, but I don't think more than two or three out of two hundred engines. I used the Low Moor tires, but they did not wear in comparison with the Bowling at all. They sheared off and laminated very badly indeed. Of late years we have adopted steel, simply because we could not get iron that would stand the use of coal as fuel. We used Bowling iron, of which we imported largely some years ago, and the last importation of which was made in 1852. Those sheets, many of them, were used up to somewhere about 1860. I used the last, I think, in 1862, and I will say that one of the engines I built in 1862 has that fire-box in yet of Bowling iron. We have imported some of that since, but only a few sheets. Since that time we could not get Bowling iron equal to that which we imported in 1852. Our last large importation was in 1852. It was a very superior article. Now, on the Erie road, I think very generally, at any rate in the Susquehanna shops, we have adopted the steel fire-box plate, or steel plates for fire-boxes, and they have been universally, with the exception of a very few sheets, the Hussey, Wells & Co's steel. I don't know that I can mention a single instance of a sheet which has been put in at Susquehanna which has given out. We have had quite a number of sheets give out in engines that have been built elsewhere and put in elsewhere—engines that the company have purchased; they have given out in the flanges, and I claim they gave out, as Mr. Hudson says, mainly because of the carelessness in flanging — the strain put upon it in flanging, and in not annealing the sheet after it was flanged to take the strain away from it. When the strain is taken entirely off the sheet after it is flanged, as we do in the Susquehanna shop, I can say I don't know of any instance where a sheet has given out. Of course they will burn out; fire-boxes will burn out after a time; but they have not given out from any cause, from inferior quality of the material used as in comparison with iron; and as one of our members here said, a few minutes ago, that one fire-box of steel would outwear two or three of iron, I will say I think I can corroborate that remark; that certainly a steel fire-box will, I am safe in saying, outwear two made of iron.

Mr. GORMAN, Toledo, Wabash & Western Railway—I like to hear this discussion. It tends to draw out opinions that will be beneficial to all. So far as steel and iron boxes are concerned, there is a great difference between the kinds of coal used. The coal in Illinois is full of sulphur and salts or other substances that tend to destroy the life of the iron. I have had fire-boxes that have been only a year and a half in use, and the sheets would crack. I have seen one crack on the road and had a temporary patch put on it to bring it home, and when it got home the boiler-makers were put to work to put a patch there. I was down on my knees looking in, and while looking in (one of the boiler-makers had tapped it with his hammer and pronounced it all right, and had started his water to run it, and it had got up about as high as the patch) I saw there was a crack on the other side. We took the fire-box out, and you could do what Mr. Eddy said he could with his steel plate. This one had only been in use a year and a half. Then we used steel, and I have steel boxes running now four years and over that I have never touched a hammer to, and they seem as good as they were the day I put them in. I think the coal has a great deal to do with it.

Mr. CHAPMAN, Cleveland & Pittsburgh Railroad—I would like to ask Mr. Eddy how long that engine has been in use of which he spoke?

Mr. EDDY, Boston & Albany Railroad—I can't tell. I should say four years or somewhere in that neighborhood.

Mr. HAYES, Illinois Central Railroad—I would like to say a word or two in reply to Mr. Eddy. He seems to accuse me of thrashing about a bush or being astraddle of a fence. If he will take my report from the first up to the very last, he will not find a single word where I recommend steel for crown and flue-sheets. There have been four reports, and this makes the fifth, and I think he will not find a single word.

Mr. EDDY, Boston & Albany Railroad—I don't say I got it from the reports. I got it from the conventions.

Mr. HAYES, Illinois Central Railroad—If I saw steel was not the thing, I would be the last man to advocate it; or if I saw steel was better than iron, I would not advocate iron. I say if we had good, pure water, as they have on many of the roads East and South, I should say, use steel on every part of the furnace, from the crown down to the sides and back and flue sheets. I advocate the same things that were advocated in my first report. I believe it was correct then. There are some things in which I have changed my mind, after experimenting, but the main part of my first report will agree with the main part of my last.

Mr. HUDSON, Rogers Locomotive Works—I would like to make a few remarks in regard to the quality of American steel for furnace purposes as compared with English steel. In fact, the American steel can hardly be said to be steel at all. It does not contain any of the properties which we usually attribute to steel. One of those very important properties is, that it shall become hardened when heated and plunged into water. I apprehend that it contains less carbon than a great many of our samples of iron that we don't pretend to call steel at all. What I wanted to say about it was this: We have recently imported English steel made on purpose for furnaces, and we find it is very much harder and it has got to be worked very carefully, and if you flange a sheet down cold, it is in danger of falling in two. I have such a sheet in the yard now. That shows that the steel they are making is too hard. A few years ago we put quite a number of tube-sheets into the engines, but eventually we had orders to abandon it. The reason was, they were breaking all the time; we could not get them to stand. It was English steel. The American makers are gradually getting so that they can make wrought iron with no carbon in it, or so little it cannot be called steel—it is homogeneous iron—which is free from lamination, and that is where its superiority for furnace iron arises.

Mr. ROBINSON, Great Western Railway—I am very sorry I was called away from the room during the reading of the report, and am not familiar with the points touched upon. For that reason I was going to suggest, before I proceed, that it would be an advantage in the discussion if we could have each question read and discussed by itself. Then there would not be any danger of passing from steel to iron, and from iron to copper, and from fire boxes to tires, and so on. So far as this discussion is concerned, I think we are all right; that is, a person in the South finds it necessary to wear thin clothes, and a person in the North must wear furs and skins to keep himself warm. So with the different roads and their relation to the question under discussion; everything depends upon the circumstances governing each particular road. For that reason, I think a road that is troubled with a peculiar kind of sediment is a very unfair sample for the whole country. Mr. Hayes, therefore, is an exception to the rule; and for that reason, I think we must each of us consider each road by itself, and its locality. In a convention like this we are all quite willing to give way to the experience of other people, and allow each his portion of the discussion to come in as one share in the basin of knowledge which we hope to stir up and get the cream from; still we must remember that each person's experience and opinion are to be regarded in connection with the circumstances governing them. The first point I notice is that of the iron of the different countries. You would naturally suppose that, my origin being English, I would be in favor of the Low Moor iron, and you must be surprised to know that I am not in favor of it. Low Moor is Yorkshire iron. There are four or five brands, Low Moor is one, Bowling is another, and Farley is another. These three are all very famous brands. In making out a specification for a locomotive in England we say Low Moor or other Yorkshire iron of equal quality, and it simply means Yorkshire iron with the same care taken in producing the iron. We have used Low Moor, Sligo, Bay State and Penn ylvania iron, and I consider for all general purposes, the Sligo is quite equal to Low Moor iron. During the time I have been on the Great Western Railroad, I have built 20 or 30 boilers. My boiler-maker looks upon it as equal to Low Moor, and the reason we do not try it is because there is to us a little advantage in the price in Low Moor. I wish to ask our friend Mr. Hayes a question, which I shall be glad to have him answer. Whether it would not be better it for crown-sheets he was to use a thinner layer of steel; I consider that thin iron is a quicker conductor of heat than thick iron, and it seems to me the difficulty might be obviated, partially at least, in that way. The great mistake they are making in Europe to-day is in the construction of thick boilers. I was in Europe last spring and I saw boilers 9-16in. thick in Glasgow, and also in Manchester. It seems to me ridiculous; because, though they get strength in the main body, in the rivets they weaken it, and lose the strength there. I think that Mr. Hayes might with advantage try a plate 1-4 or 3-16 of an inch thick. It seems to me that will show that deposit much quicker than a thick plate. Then in bending up the plate, if it was thinner it would not lose its tensile strength so quickly and might be bent up into its place. In regard to English iron for fire boxes, I think one of the members of the convention spoke of dispensing with steel entirely. We have gone through a great many changes—copper, steel, Low Moor iron, Sligo and other descriptions. Some of our engines were built in Stephenson's shop at Newcastle-on-Tyne, and in breaking one of those (we are breaking up all our engines and introducing the American style of gauge) we took out the fire-box built by the makers, and in taking it out it flew all to pieces like glass. You might take a piece a foot square and tap it and break it. That engine had been running with 110 pounds of steam up to that time. I felt a sort of fear and thought we were running an unwarrantable risk with the engine. It shows that the iron had undergone a change. I considered it had been converted into steel. It had no fibre at all; it was more like cast iron than anything else. If iron turns in that manner, I don't think any of us would recommend it. The iron in that state seems to become more brittle. Steel being of that natnre, and prepared suitably for it and made much thinner than this iron is, I think is less liable to this fracturing or brittling process than iron or copper. Copper acts in the same way. When we have taken out copper boxes, I have seen copper that you could break in two like an ordinary biscuit. That is due to the burning of the copper sometime when we have not been aware of it. With the steel boxes we have not had any complaint whatever. Firth, of Sheffield, seems to be a good brand. When I say that England might produce the best iron, I might also say that America produces the best steel. I don't think there is any reason for entering into a discussion that would lead to anything like feeling on such a point. It is almost a commercial question only, and I do not think any mechanic wishes to make this convention a medium for conveying trade from one to another. What we want to get at here is the facts.

Mr. Robinson's motion, that each question be read separately and then discussed, was then agreed to.

The first question, with the reply thereto, was then read by the Secretary.

Mr. EDDY, Boston & Albany Railroad—I don't believe we shall any of us know much more than we do now if we discuss that all day. I move that it be passed without discussion.

THE SECRETARY—I hope that motion will not be carried. If I understand the matter, we are here for the purpose of discussing these questions, and therein are we to get the chief benefit from the reports. The reports may be able and exhaustive, but there are little experiences that may be detailed by each member that will be of infinite value to us when we go home to our shops, and I hope the discussion will be carried out, if it takes all the week. Let us attend to business while we are here.

Mr. EDDY, Boston & Albany Railroad—I withdraw the motion. I didn't make it to choke off anybody or stop discussion.

Mr. FORNEY—Before proceeding with this discussion, I think it would be a good plan for the members to exchange views with each other, and I move that we take a recess of ten minutes.

Mr. ELLIOTT, Ohio & Mississippi Railroad—In that report there are two or three points we can discuss to good advantage. That is, the subjects we have had under discussion and the advantages of the wagon-top or straight boiler. There are points there worth consideration. I don't think it is worth while to spend too much time on them, although they are important, for if we take up every subject, and every man is to have his say, we shall never get through with the meeting.

Mr. WELLS, Jeffersonville, Madison & Indianapolis Railroad—As this question is now before us, I hope any and every member who has anything to say upon the subject will get up now and let us hear what it is. If no one has anything to say, we may as well pass that and go to the next. For my part, I have had no experience with any but the plain fire-boxes.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I look at it in this light: If it is voted that we discuss it, and any one has any remarks to make, let him go on and make them; if no one has any remarks to make, this motion disposes of it at once.

Mr. EDDY, Boston & Albany Railroad—I didn't make the motion to stop any discussion. I thought we could spend our time to better advantage—that is all.

Mr. Eddy's motion was lost, and Mr. Forney's motion for a recess agreed to, and the recess taken.

THE PRESIDENT—Has any one anything to say on the first question on boilers and boiler materials?

Mr. GRANT, Rockford, Rock Island & St. Louis Railroad—Coming from the different sections of the country as we do, we all come with different conclusions, with our minds made up from the localities in which we are. Different kinds of iron and different kinds of coal are used in different localities, and also different kinds of water. Where I have been last engaged, we have seven locomotives with steel fire-boxes, known as Lancaster engines, five of which (none of them have been in use three years) have been almost entirely out of use for two years on account of the steel fire-boxes. I must say, for one, that from this experience I have been very much discouraged with the use of steel. I prefer Tennessee charcoal iron for fire-boxes.

Mr. HAYES, Illinois Central Railroad.—I would like to ask what brand of steel he is speaking of.

Mr. GRANT, Rockford, Rock Island & St. Louis Railroad—I have no way of ascertaining except upon examination of the fire-box from which it was taken out, and we could not find any brand whatever. We cleansed the plates to discover the brand of the steel, but were really unable to find any. I don't know that what I say would come exactly under the head of this question, but I am in favor of using the plain fire-box, and so far that has been my experience in the locality in which I have been engaged.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I suppose the subject of brick arches comes under this question. To test the brick arch we had the brick arch put in alternately. The odd numbers had the brick arch and the even numbers the plain fire-box. We commenced running, and for a long time it was a very difficult matter to tell whether there was any advantage in one over the other in steam or in consumption of fuel. Apparently, at first, there seemed to be a little advantage in favor of the brick arch; but it was first one way and then the other. The different trains and circumstances might have made all the difference. Of course there were different men running the different engines. We run them until the brick arches failed. I was very particular to tell the men to watch and see if they could tell any difference after the brick arch was taken out, and previously when it was all in good shape, and I believe the general conclusion of all the men was that there was not enough difference, not enough advantage, to pay for renewing it, and therefore we have not renewed our brick arches. I believe that is a fair test. I have watched it very closely, and that is our conclusion in the matter.

Mr. HAYES, Illinois Central Railroad—I would like to ask Mr. Elliott, supposing there was no difference in the amount of fuel consumed, would not the prevention of gas passing off and annoying the passengers in the train compensate for the expense and use of the brick arch?

Mr. ELLIOTT, Ohio and Mississippi Railroad—I think not. I think this can be overcome in another way. However, these engines were all freight engines; they were not used on passenger engines, where we were more particular. These engines all went into the same service, and performed the same service as near as we could determine it, with substantially the same consumption of fuel. All railroad men know the difficulty of exactly reaching the points of the number of cars, the tonnage hauled, etc. It is a very difficult matter to get at exactly, but I think the general use of forty engines, altogether, is a better criterion than any figures we could find.

Mr. SHAVER, Pennsylvania Railroad.—We use the brick arch altogether, in all of our passenger engines. We have two freight engines that have been at work two years in December, in one of which I put a brick arch, the other having the plain fire-box. The one with the brick arch has burned less coal and done the same amount of work. Both run on the same schedule. The one with the brick arch has, if there is any difference, the most work to do—more shifting to do. The one without the brick arch has had the flues taken all out once, and part of them twice; whereas the one with the brick arch has never had any flues taken out. There appears to be in these engines a decided difference in favor of the brick arch.

Mr. MAYNES, Selma, Rome & Dalton Railroad—I have had some experience with one brick arch. I think it was in February last we got the last of 15 engines that were built for the company, and the last one came with what is called the brick arch. She made one trip on a passenger train and after that laid in the house until I went out with her afterwards for a trial trip over the road. Mr. Tucker was very anxious to have the engine tested thoroughly. She was got up for the purpose of burning coal. We used hard wood—what we call buckhorn—full of knots and pitch. We left Selma with an ordinary train, starting out with 27 cars, 9 heavily loaded. Fifteen cars are an ordinary load. We go as high as 17—depending upon how heavily they are loaded—but 15 are an average good train. We made a good run with the buckhorns. They will make as much smoke as any bituminous coal, and while she had them she made steam freely. At Calera we had to take straight wood, and then she failed on me and got stalled twice before I got in where the passenger train ought to pass me. There I left her. She came in with twenty cars and the nine loaded ones that same day to Childersburg. Going from there she took straight wood a short distance out to Alpine, where they got hold of some of this buckhorn, and had no trouble in getting in; and when she got back to Selma she had made 640 miles. The ordinary work of an engine is 320 miles on a round trip. She had doubled back part of the time She made 640 miles and burned half a cord less wood than an engine running 320 miles. We used it until the brick arch fell down. The first brick were two and a half inches thick. Tney sent me an extra set, five inches thick, and we used them until they were burned up. The difficulty with the brick arch is, it is almost impossible to keep firemen from throwing wood against the brick. They would get out on the road and throw in the wood, and down the brick would go, and we would have to get up a little derrick in the fire-box to get the brick up. If the thing could be put in so as to stay there, or for use with coal, I am in favor of the brick arch, perhaps with some change in the front end. I think if we had tried it again and taken pains to keep the front end clear, she would go very well.

Mr. GREGG, Erie Railway—The discussion seems to turn upon whether this brick arch is any improvement on the common plain fire-box. I have used the brick arch some years ago, as perhaps almost all the master mechanics have used almost everything that has been offered that looked likely to economize fuel. I am like the rest of them, having experimented with this arrangement and that arrangement, until of course, like the rest of our master mechanics, I have got about tired out with all of them. About a year ago, in order to test the plain fire-box and know whether it was not about as good as anything we could get as a fire-box, we made some experiments at Susquehanna with the plain fire-box, both in freight and passenger engines. I have the result of those experiments here, which I will simply note down, as these gentlemen have not brought forward any data whatever to determine whether their plan was better than the plain fire-box. I want to give these figures, and gentlemen can make use of them as they think best. We have four forty-ton freight engines at the Susquehanna shop, two of them running west and two east from that shop. The two west run 142 miles, the other two east 104 miles over each respective division. These four freight engines averaged 8.12 lbs. of water to one pound of coal, drawing 35 loaded cars in each train at an average speed of 18 miles an hour. You must recollect on the Erie road we have what is called a wide gauge, and our cars are very much heavier in every way than your narrow-gauge cars. Perhaps they will average anywhere from ten to fifteen per cent. heavier at least. I presume fifteen per cent. heavier. This trial was made by weighing the coal and also the water. The trial was carefully made for 14 days in succession with those four engines, and I give you the result. We also took four passenger engines of 30 tons each—our ordinary passenger engines, running on our first-class trains. Those averaged 6.75 lbs. of water to one pound of coal, drawing a train of 9½ cars at an average rate of speed of 43 miles per hour, and I will venture to say that two of our cars will make at least three of the ordinary narrow-gauge cars, take the whole country through. They are very long and wide and necessarily built very much heavier in proportion than the narrow-gauge cars. That is the result of the plain fire-boxes using bituminous coal. I have used the same arrangement that these gentlemen speak of—the fire-brick arch, and finally threw it away and came to the conclusion it was of no advantage. Then I have also used the deep combustion chamber that was introduced and thought to be a most excellent thing. I have used that as deep as four feet, reducing that down from time to time to six inches, thinking that was an advantage, and finally gave the whole thing up and put in the flue-sheet the whole depth of the fire-box from the top to

the bottom. Most of our people, I think, as a general thing, build fire-boxes with the flue-sheet in two parts, thinking it necessary and that we can replace a flue-sheet much easier putting it in in part than in whole. It is a mistaken notion, of course. Oftentimes, perhaps nine times out of ten, the sheet gives way at that seam before any other part of it gives way at all. The seam burns out, and we have to take out not only the top but the bottom part of it entirely, so I have adopted the usage of putting in a solid sheet from top to bottom, or from bottom to top, to do away with that seam. I have given you the result of the plain fire-box. If any of you have a result in figures of any new plan of economizing fuel, I would like to have it, and I would like to have it in figures.

THE SECRETARY—Mr. Towne gives a comparison of the plain with that of the water leg in this report.

Mr. TOWNE, Hannibal & St. Joseph Railroad—I will simply state, before that is read, that I believe the only thing that can be depended upon in this matter is this statement: A simple experiment with an engine for any particular number of miles on one occasion is no experiment at all. These experiments which are referred to I think are taken from six months' trial, a careful record being kept, and it is substantially correct. I would state that the engines we used at that time were somewhat out of repair, but I don't regard it as any detriment to the use of coal in the plain box on that account. I have the Jauriet fire-box, which is substantially the same thing as the brick arch. So far as my experience has gone, I think all our engines are doing very much better than any plain boxes we have ever used for bituminous coal. It may be that the plain box will do better on other roads than on ours, but that remains to be proven. We can only tell that by experiment. We are still using the Jauriet water-leg with good results. We are running 41 to 48 miles on a ton of coal, on the average, and our passenger engines run up to 48 and 50. Our passenger trains are very heavy—6 to 9 cars—over a road that is very heavily graded. Our heaviest grades run up to 90 feet. We have had, up to within the last year, grades even heavier than that. Our passenger trains at present are lighter. We are running four to eight coaches, and are making 50 to 55 miles to the ton of coal. I think the use of coal depends very much upon the manner of using it. Stoking is a very important matter in the use of coal. Good firemen, well drilled in firing, will make ten miles to the ton better than those who have no experience in firing engines. I have no doubt if you put into the fireman on to one of our engines she will not do as well (in fact, I know it to be the case, by at least ten miles to the ton of coal) as with one that has been drilled in the use of coal. An engine will burn all the coal you put into her; that is, it will get rid of it in some way. The secret of firing is, to keep the coal out of the engine. I believe an engine with the water-leg will burn less than with the plain fire-box, because you have the advantage of the consumption of the gas. If there is any principle at all in what is called a base-burning stove, we have approached that somewhat in the use of the water-leg or brick arch in the locomotive. If we get to it nearer, we shall have a still better engine. Now I refer particularly to these experiments on the Hannibal & St. Joseph road of the Jauriet water-leg compared with the plain box. They were not experiments, but simply a record of the performances of the engines.

THE SECRETARY—I would like to inquire, if at the time those engines were changed from the plain fire-box to the water leg, there was not more or less work upon the packing, etc.

Mr. TOWNE, Hannibal & St. Joseph Railroad—Yes, sir, there was; so also was the same amount of work done to the plain boxes. When the plain boxes needed the valves faced, of course it was done.

THE SECRETARY—I would like to ask Mr. Towne if he has not noticed it as a fact that when an engine's valves begin to blow, the engineer will run perhaps a week or two before reporting that his valves need facing; and when the engine is brought in and the valves faced, the engineer will say she burns one-fourth or one-third less coal, or she don't burn half as much coal, and if he has not actually seen it make that difference in a little work on the packing of the valves?

Mr. TOWNE, Hannibal & St. Joseph Railroad—Yes, sir; no question about that. Keep your engines up; keep your packing good, and the valves faced you do better. So with long valves. Allow your motion to get out of order, and your long valves are a detriment; but if you keep the motion up they are better than short valves. Our valves are none of them less than $\frac{7}{8}$ lap. Of course the motion must be maintained to get good results.

Mr. GREGG, Erie Railway—The gentleman suggests that my experiments were not fair, because it was only one engine at a time that we used. I said that we used four engines. There were four freight and four passenger engines taken, and they were used along from day to day for fourteen days in succession. I would also say that those engines were not put into the shop and put into condition for those experiments, but were taken indiscriminately from the mass of engines run on the road, without any preparation whatever or any extra pains taken to determine the matter, other than to have a fair experiment with ordinary engines in ordinary use, nothing more.

Mr. PHILBRICK, Maine Central Railroad—I would like to ask Mr. Gregg the condition of the coal he used. I happen to be on a road a long way from coal mines. We get our coal very fine. It appears to be the scrapings up of what they don't want in Pennsylvania, and we require the brick arch. I would like to ask if their coal is good, clean, coarse coal, or a fine coal.

Mr. GREGG, Erie Railway—I would answer that by stating that the coal we use is simply what we call the run of the mine. About one-third of that coal may be considered medium coal; the other two-thirds fine coal, or what we would regard as blacksmith's coal.

THE PRESIDENT—The coal used in this section is fine, like meal, hardly enough lumps to start a fire with, and has to be wet down to get it into the fire-box, and that is why we need the brick arch.

Mr. FORNEY—I should like to inquire whether the size of the locomotive boilers has not more to do with the economical combustion of coal than the peculiar style of fire-box. I have noticed with a small boiler working very hard, when the fire must be forced to its extreme limit, that the coal is drawn over the grate, up the flues and out of the stack, and goes off unconsumed. So with the gas. The smoke has not time to be consumed. You have to force the fire too hard for consumption. If you take a train of thirty cars, I think the engine with the largest boiler will show the most favorable consumption of coal. There is another feature about this. In running on a level road, if you have a large boiler and the boiler is not working up to its extreme limits, it is possible to fill it tolerably full of water, so in running up a grade you have a large amount of hot water to use in going up the grade; whereas if it is a small boiler you have to use it all up. I am aware that on a heavy grade you cannot depend much on the water, but it seems to me the advantage of a large boiler in this respect is a great advantage. I would like to have the master mechanics give their expression in relation to this point—whether there is any limit to the size of boiler it is advantageous to use. If you have a thirty-ton engine, there is of course a limit beyond which you cannot go without increasing the size of the engine; but with such an engine, within that limit, can you have a boiler too large for the economical consumption of coal?

The Secretary read from the report the paragraph giving Mr. Wells' views.

Mr. TOWNE, Hannibal & St. Joseph Railroad—In order to verify that statement, I would say we had half a dozen engines, more or less, with a 35-inch boiler, using the Jauriet fire-box, that run from 32 to 38 miles to a ton of coal, where our engines with a 48-inch boiler, doing the same service, are running 42 to 45 miles to the ton of coal.

Mr. WELLS, Jeffersonville, Missouri & Indianapolis Railroad—I think Mr. Gregg's statement verifies that. It seems the evaporation was greater per pound of fuel in the freight engines, which I presume are larger than the passenger engines, than it was where the speed was high and the evaporation necessarily must be rapid. Now we all know that freight engines run slower and the number of cubic feet of steam furnished per hour is less than passenger engines, where they are worked up to their full capacity, and according to his statement the difference in evaporation there was about twenty per cent. in favor of the freight engines, and I cannot see that there is any other reason than that it was slower and there was more time given.

Mr. HUDSON, Rogers Locomotive Works—I apprehend that there are other circumstances which would modify the results as to the different kinds of furnaces than whether one had the Jauriet furnace and the other the plain furnace—the mode of admitting the air, the quantity of air admitted, the length of time before the gas reaches the tubes—because it is well known that if perfect combustion does not take place before the gases enter the tubes, it will not be completed afterward; therefore combustion must take place in the furnace. Theoretically, the fire-brick arch is the best thing to accomplish that purpose, because it causes an eddy in the gases and gives them more time to mix with the air and makes them run longer before they reach the tubes and affords them a better opportunity for perfect combustion. On the contrary, the water-leg furnaces, like the Jauriet, while they give a longer run to the gases and do, to a certain extent, increase the economy of consumption—I have no doubt about that—at the same time they do, to a certain extent, defeat the very object which the water-leg is put in to serve, that is, by absorbing heat which is necessary to the perfect union of the oxygen and gases. In other words, carburetted hydrogen must be of a certain temperature to unite with the air, or the carbon will be deposited in a solid state and go out in the shape of soot, that adds nothing to the efficiency of the boiler. I should like to inquire if any member of this Convention has any knowledge of the practical operation of those furnaces on the Hudson River road or the Cumberland road. Theoretically, the brick arch is the best calculated to fulfill the object in view, if the air is admitted properly. I might refer to an apparatus which is referred to in that report, a sort of shoot put into the furnace door and bent downwards two feet or more. I was very much struck with the efficiency of that device. The doors are made to slide sideways. They are partially opened, air is admitted and is deflected downwards, rolls over and mixes with the gases and increases the time which the gases are in mixing with the air and in reaching the tubes, giving a better opportunity for perfect combustion. After having seen the operation of this furnace and that shoot with that peculiar kind of door in England, we were building some engines for South America, and Mr. E. P. Gould, formerly of the Jersey City Locomotive Works, was connected with the road, and I proposed to put on that apparatus, and he consented; and he reports that it works remarkably well, and all the engines we have built for that country have that apparatus, and from the reports I hear from it, it answers admirably for the purpose for which it is intended, and there is very little emission of smoke with highly bituminous coal.

Mr. SELLERS—Mr. Hudson has expressed my views entirely, but it is an established fact, established beyond controversy, that the reason we don't have perfect combustion is, our exhaust draws our air through our fire so rapidly that perfect combustion cannot ensue, and the only way to remedy that is to enlarge our grate-surface and have a larger surface to pass through and let it pass through slower.

Mr. HILL, Erie Railway—Since these experiments, we have built four locomotives, 18x24-inch cylinder, 43-ton engines, with fire-boxes 66x40 inches, and I must say I was astonished to see the small quantity of fuel those engines consume. I dont think they burn two-thirds the fuel of some engines with the same size of cylinder. The air passes through slower and there is perfect combustion. In riding 100 miles, you will not see a particle of black smoke, except when you are putting in fresh coal. The fire-boxes are 66 inches in length and 40 inches high. The side-rods are 8ft. 6in.

Mr. HUDSON, Rogers Locomotive Works—I would like to ask if the Erie road has not had some experience in burning bituminous coal in engines originally constructed for burning anthracite, with furnaces eight feet or more in length?

Mr. HILL, Erie Railway—We burned nearly a year ago bituminous coal in anthracite burners. It did very well. We could not find much fault, except the fire came so near the flues. It made them leak. We took one of them that was leaking, and took the bituminous coal out and used anthracite, and it dried up, which shows that a deep fire-box is essential for bituminous coal. We use as deep for bituminous coal as we would for wood.

Mr. HUDSON, Rogers Locomotive Works—The term narrow gauge in contradistinction to the 6ft. gauge, I presume does not imply the 2½ or 3ft. gauge, but the 4ft. 8½in., 4ft. 10in., or 5 ft., because I think it is important that the report should not make that mistake—that it is narrower than ordinary gauge.

Mr. TOWNE, Hannibal & St. Joseph Railroad—There is no question at all about the advantage of the large boxes for burning coal. We always put in just as large as we can get them in, and in some instances I have spread the drivers, and put in new frames to get longer boxes. Burning the coal that we use in our country, we get better advantages with large boxes than with small ones. The only point is to confine the gasses so that they may be consumed. It requires 300,000 cubic feet of air to burn a ton of coal. We put in 48 to 50 one-inch air tubes in the Jauriet boxes and then sometimes don't get air enough. If the air could be admitted regularly, or at intervals, when it is required, and stopped off when it is not required, it would be much better. I always have the coal broken to a certain size before being used; about an egg size is the best size for burning in the Jauriet box, or I presume, in any other box. We run from 3 inches to 4½ inches of coal on the grate, sometimes it gets as high as 8 on the freight engines. I have no doubt with close firing we should get better results. If our boxes were 12 inches longer, I have no doubt we would get 20 per cent. better results.

Mr. SELLERS, of Pittsburgh—For a great many years we have been trying to burn our black smoke. We have tried to do it after distilling the smoke from the coal. It is a mistake to think that we can get perfect combustion after it has been distilled. You can partly, but you must precipitate the carbon and send it off in the shape of soot. The only way to get perfect combustion is to burn the gases as they are distilled, and the only way you can do that is to keep them in contact with the coal long enough to burn. We have no doubt but some good is derived by using air-blasts on the top of the smoke, but it is little good. We are looking after a will-o'the-wisp. We can never get perfect combustion after the coal has been distilled in the shape of black smoke. I say the only way is to have a large firebox and pass your draft up slowly and burn it as it is distilled.

Mr. ELLIOTT, Ohio & Mississippi Railroad—I have been using air tubes for a number of years, and I find a great advantage in using them, in the smoke. When you let the air in before, it is too close to the flue-sheet. It ignites the gas after it is left up in the fire-box some distance. You can see it going on over this air opening, and where you admit the air the gases blaze and there is combustion, and the question to be arrived at is, as between the air opening above and the grate opening below. I have experimented to some extent to reduce the grate opening, and find there is a point in connection with those air openings that gives the best results in combustion. The engine is freer from gases and freer from smoke. I think there is so little difference between the brick arch and plain fire-box it would hardly justify putting them in. I think our experience with 40 engines, all of one class, with no prejudice, but giving the thing close observation, almost demonstrates the fact. They are large engines, well built, 16-inch cylinders, and they gave the result I spoke of. Some engines would do better with the arch, and others again without, just the difference we all of us find in engines, and cannot account for. I admit, with a small fire-box there may be some benefit from the brick arch; by carrying the gases round you get some advantage, but that is the whole advantage derived, I believe, from the arch.

Mr. FRYE, Grand Trunk Railway—My experience corroborates certain facts mentioned by Mr. Elliott and Mr. Sellers. I had about eight years' experience on a railway in England under the superintendence of Mr. Cudworth, whose name stands very high as a successful coal-burning man. For two years I did scarcely anything else but run experiments with his engines. His fire-box is similar to that described by Mr. Sellers, a very large one,—a fire-box that is deep near the tubes; but instead of having that depth back to the back part of the fire-box, he brings his bars level with the smoke-box door. That enables the fireman, when burning a very bituminous coal, or a coal that is very fine and apt to run into slag, to put the slides down and stir it up, and by having it long—eight feet in length,—he has a slow fire and gives the gases time to burn before they reach the tubes. The idea is, the coal is thrown on the front end of the fire, and as it burns it shakes down towards the lower part, where an intense white heat burned the gases before they left the tubes. The fact that Mr. Elliot mentioned about the admission of air, we noticed, and introduced a sliding door to the grate, and whenever the driver saw smoke was being emitted, he pulled open the grate and the admission of air checked the smoke. It was invariable and could be seen at any moment, and when the smoke passed away, not to cool his fire he shut the grate again. The results obtained from these engines were always equal to, and we thought rather superior to, those obtained from any brick arch. I never saw any experiments with the engines as against a brick arch, because there were no brick arches when I joined the road. They had been used and been discarded. I was employed one summer to find out the exact combustion for a mile and the number of pounds of water evaporated. With careful firing we could equal the result mentioned by Mr. Gregg, namely, eight pounds of water to a pound of fuel; and with the very best kind of coal we could sometimes get nine pounds of water per pound of fuel, and I would say that the consumption of smoke was always much better than upon those engines having a brick arch. In England much more attention has been paid to the consumption of smoke, owing to the large number of towns passed through. Our line run through three towns in London. It was important that the smoke should be burned. If any smoke was emitted we were fined. We never adopted the brick arch, and our consumption of fuel was quite as good as any line using the brick arch, and we saved the expense of it and the danger of having the train stopped by having the brick arch fall down, which frequently happened on other roads. I believe a very careful series of experiments was instituted last year between the Cudworth fire-box and the Beattie fire-box. The trains took the same number of cars and they run the same train at the same rate of speed, and the Cudworth, without the brick arch, gave to the consumption of fuel about one pound of water more. I have this from private sources and not from official sources, and could not vouch for its accuracy; but the fact of nine pounds under favorable circumstances and eight pounds under ordinary circumstances I can vouch for. The same number of cars were taken upon the same train; the same number of stops made; the coal was very carefully weighed, and the water very carefully measured. I would say that the two great advantages that were considered to be gained were having the long box, so there should be a slow combustion of the gases, and then the fact of being able to admit air at the back end of the fire-box, and as our bars came up level with the fire-box door, it was impossible to put in the long scoop.

Mr. FORNEY—I would like to inquire in regard to the length of the fire-box, and whether they had a mid-feather and inclined grate; whether they were fired on one side and then on the other, and to what extent that influenced the combustion.

Mr. FRYE—The idea was, in designing the box, that they should be fired alternately, and a mid-feather was run from the back end of the fire-box almost to the tube-sheet, and the intention was the man should fire alternately; but it was found that with a fire-box 7ft. 7in. inside length, the consumption was so good that it was unnecessary and the firemen fired both.

Mr. FORNEY—Could the same effects be produced without the mid-feather?

Mr. FRYE—I don't know. We always thought the same effects could be produced without it. I have seen engines without it on the Chatham & Dover Railway, but the engines did not have exactly the same design. The fire-bars did not come flush with the door. One foot in seven was the slope. I believe in the engraving the slope is rather more, but that is the standard slope.

Mr. FORNEY—With the working of the engine did the coal work forward?

Mr. FRYE—Oh, yes; we always found that it worked forward.

Mr. FORNEY—Was it necessary to push it forward with a poker?

Mr. FRYE—Never with a poker unless it was clinked, and then only once or twice on a journey. The operation of firing was to run a shovel in underneath and lift it up, and then throw loose coal on top. We always noticed that the difficulty was to get good firemen; not but anybody could fire easily, but it was difficult to get men to come up to the standard of our best men. We found a great difference in the results obtained by different men on the engines.

Moving Trains by Sail.

Col. J. H. Simpson, of the United States Corps of Engineers, in a letter to Mr. J. C. Thompson, President of the Peteler Portable Railroad Company (in which, by the way, he says he has used the Peteler track and cars with the most satisfactory results in light-house construction and has a section a mile long now at Matagorda Light-House), calls attention to the following passage in the report for the month of May of his assistant, Maj. A. N. Damrell, referring to the use of the Peteler railroad in constructing the Matagorda Light-House:

"Transportation of material over the railroad at this work has been much facilitated by using a sail on the cars. As great speed as a mile in 2¼ minutes was obtained by this means, and the heaviest loads the cars could take were moved along as well almost as if the cars were propelled by steam. It was found that the cars would sail almost as close to the wind as a boat."

English Fast Train.

The Great Northern Railway Company is now running a fast train between London and Edinburgh, 395 miles, in 9¼ hours, which is at the rate of about 42 miles an hour.

RAILROAD GAZETTE

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Editorial Announcements.

Address.—The RAILROAD GAZETTE *will be printed for the present in New York; our printing house in Chicago having been destroyed. All communications, therefore, whether editorial or business, should be directed to the New York office. The proprietor will receive subscriptions and advertisements at his office in Chicago, Nos. 63 and 65 South Canal street, but letters should be addressed to New York.*

Correspondence.—We cordially invite the co-operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Inventions.—No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

THE NARROW-GAUGE CONVENTION.

The Narrow-Gauge Convention appointed a committee to make an elaborate report on the subject of narrow-gauge railroads. This report was read at the very close of the Convention, and was referred back to the committee for revision and publication. The St. Louis papers of Saturday give it in full, being sufficient to cover something more than two pages of the GAZETTE. We are unable to find room for it this week, and perhaps an abridgement of it will be quite as valuable as the whole.

The committee recommend that three feet be adopted as the standard narrow gauge, and 24 inches as the standard height for the centre of the draw-head from the top of the rails.

The comparative cost of construction of "the old and new systems" in "rough, mountainous countries," it is stated, will *not be over one-fifth* that of such roads as the Erie, Pennsylvania, and Baltimore & Ohio roads. In "broken, rolling country *one-half*, and in slightly undulating prairie or plains country *three-fifths*."

We doubt whether any one will have the hardihood to deny these statements. In fact, they could have been made much stronger and still have been within the bounds at least of the letter of the truth. It would, for example, be quite possible to build a narrow-gauge road, in "rough, mountainous countries," which would cost a great deal less than one-fifth as much as the Erie, Pennsylvania or Baltimore & Ohio. In fact, we believe that a narrow-gauge road could be built, whose "capacity could at any time be increased by capital," which would not cost one one-hundredth as much per mile as the roads named have cost in similar sections. In furnishing such estimates care must be taken, however, not to specify the kind of facilities which will be afforded by the two roads. The comparisons made by the committee with reference to the cost of the two systems are very much as though it were stated that a log house in a mountainous section costs only one-fifth what a frame house on Clinton avenue, Brooklyn, costs; and reasoning therefrom that the log system of building is, therefore, to that extent, the most economical form of constructing houses.

The report also contains the statement that it is easier to obtain $10,000 than $30,000 per mile to build a road, and that the committee is unable to see the economy of investing $20,000 per mile when $10,000 will accomplish "the desired object"—than which we doubt whether any more proper and correct financial statements could be made: but they are silent to a very remarkable degree in their specification of what the "desired objects" are. If the traffic is to be carried at five miles per hour and the passengers accommodated with about the same room as the same number of corpses would require, then they are quite within bounds in what they say. If, on the other hand, they should assert that the "desired object" is accommodation, convenience and speed equal to those furnished by the roads named, then their statements are simply absurd. What they did aim at was, to say that narrow-gauge railroads which would afford all *requisite* facilities for the traffic in mountainous countries would cost in comparison with the roads named only one-fifth as much; but it will be noted that the committee is very careful not to state the relative cost of narrow and standard (4ft. 8½in.) gauge roads which would supply exactly *the same facilities* for the traffic. Of this subject the whole report is remarkably silent.

The committee has given a very elaborate comparison of the relative weights of rolling stock, for narrow and standard-gauge roads. In nearly every instance, either the comparison or the inferences therefrom are entirely unfair, as has been frequently shown in the RAILROAD GAZETTE. One very glaring example of this is shown in the comparison of an ordinary freight car with Mr. Fairlie's India narrow-gauge cotton car, which is said to weigh 3,000 pounds and to carry 10,800 pounds of cotton. This is a *four-wheeled platform car* without any covering for its freight excepting a tarpaulin, and is compared with *an eight-wheeled box car!* That a narrow-gauge eight-wheeled box car which weighs four tons will carry eight tons of the *same freight* of which an ordinary car of the same kind for a standard gauge will carry only ten, we simply do not believe; and so far as the cars of this kind for the Denver & Rio Grande Railway are concerned, we have heretofore shown that such cannot be the case.

The committee also make some elaborate calculations regarding the reduction of cost of carrying freight on the narrow gauge, as compared with that of operating standard-gauge roads. As these are all based on the assumed reduction of the weight of rolling stock, it is hardly necessary to point out how fallacious these calculations are, so far, at least, as they show the advantages of the one gauge over the other.

On the reasons why there should be any great difference in the cost of construction or the weight of cars, the report is entirely silent. There is, we believe, no word indicating that shorter curves can be used on the one gauge than on the other, which, being a stock argument in favor of their system, is a serious omission. If cars really do weigh so much less for the one road than for the other, what is the reason for it? and if curves of much shorter radius can be used, it would seem to be important that those who are projecting so many thousands of miles of new roads should know the exact difference in train resistance which is due to the gauge, which none of them now seem to know.

FREE PASSES.

The free-pass system, which is almost universal, and seems to have been acquiesced in by all American railroad companies as a necessity of their existence, has become so great an abuse as to threaten the prosperity of the railroads, the integrity of their managers and the honor of the American people. The magnitude of this increasing evil is demonstrated by the answer to the question, Who are they who receive and use free passes?

Omitting from our enumeration the President and Vice-President of the United States, the secretaries forming the Cabinet, and those mighty personages of political influence who are entitled, by the divine right of power, to special cars and special trains, we come down to heads of departments and important clerks in the departments of the Federal Government, whom one might expect to pay fare, if it were not known that they almost all have passes whenever they find it necessary to travel. Senators and members of the House of Representatives generally receive annual passes over the roads upon which they reside; and, very commonly, over the lines which they must traverse to reach the Capital, they procure trip passes to go and return. The members of the legislatures of the several States expect, and usually receive, the same favors in reaching their respective capitals; so do the eminent members of the several lobbies. The judges of nearly all the State courts and of the United States district and circuit courts (we do not know how it is with the United States Supreme Court) *sit in the trial of causes with the annual passes of the interested railroad companies in their pockets.* The sheriffs and constables also frequently have them, or more frequently receive trip-passes on demand. The mayors and aldermen, boards of public works and executive officers of such boards, the chiefs of police, of large cities and small, expect and receive annual or trip passes from the railroads upon which they can bring an influence to bear. The police justices are favored very much in the same way.

Not descending to smaller particulars, we leave the governing classes and come to the Fourth Estate. If there is such a thing as subordination of the press, it exists in the *courtesies* of the railroad companies towards the members of our profession. An annual pass in return for an advertisement published in every issue, is a matter of contract generally, and may be—sometimes it is—a cheap way for railroads to advertise; yet it would be a more direct way of doing business and more equable if the advertisement and necessary tickets were both paid for in money. But this aside, the proprietors, editors and reporters of influential papers ask and receive passes over all roads whose interests are involved with their silence upon disagreeable topics. The usual plea is, that these favors are paid for by the complimentary notices of the road and of the "distinguished abilities" of the eminent men who administer the roads which are the subject of the notices; but saying nothing of the morality of purchased commendations, this is generally not the fact. By the confession of those from whose reluctant hands such *courtesies* are wrung, we know that it is often the fear of an editor's revenge which gains the pass. But let us throw the mantle of charity over these sins of our brethren and move on.

We reach the proprietors of hotels, the "gentlemanly clerks" of the same, the head porters also, the depot runners of them also, the proprietors and drivers of stage coach lines, the proprietors of omnibus lines, the owners and captains of steamboat lines, and the stewards and pilots—these all receive passes because of their great influence upon the traveling public.

We mention in this connection, and last, the clergy, because, as a general rule, they are passed only half way, that is, upon the lines upon which they reside they receive certificates which entitle them to tickets at half price. This general custom shows a real human sympathy with morality and religion on the part of railroad managers, and does not partake much of the obnoxious character of free passes; although, no doubt, it does soften somewhat the voice of men whose duty it should be to cry aloud and spare not. But if a clergyman has a mission and a mission-field, he is very likely to apply for a pass with which to carry the one to the other; although *he* may be refused, since, however much he may discuss the broad and the narrow way, he does not often exert much influence upon people as to the route they travel.

All railroad presidents, superintendents, general ticket agents, general freight agents, general passenger agents, and other prominent officials receive annual passes over all, or nearly all, the railroads of the United States and Canada. Only a few lines refuse this exchange. All railroad conductors and locomotive engineers pass *ex officio*, if they have letters showing their employment, over any roads upon which they may desire to travel, generally with approval of the managers; but if not with it, yet through the free-masonry of their craft. Nearly all the railroads of this country issue passes to the employees of other roads, upon request of the superintendent of the road upon which they are employed. All heavy shippers upon railroads, where there is any competition, procure passes for themselves, their friends and their clerks, upon application to the freight agent with whom they do business; the stock drovers, manufacturers, mercantile travelers, and all who in any way affect the course of passengers or of freight, expect to ride free—and generally do.

There are struggling railroad companies, scarcely able to pay the interest of their bonds, which find the number of miles traveled by "dead heads" to be *one-fifth* of the whole number of miles traveled on their lines!

We could extend our specifications a long column yet, were it not that we have said enough to reveal, to a reflecting mind, a great evil; but we shall have done only half, or less than half, justice to our subject, if we fail to add that all the persons whom we have enumerated expect and ask that their wives and children shall be passed; and if they are influential persons, that their more distant relatives, or personal friends, or political confederates, shall be passed also. Railroad officials freely pass their friends and relatives over their own roads; generally too, the wives and children of employees.

These statements of the proportions of the free pass system of the United States are made after considerable investigation of the matter, and are believed to present a picture which candid men, acquainted with the subject, will say is true in outline, although the details require to

be filled in. For these we have neither space nor time; we have fulfilled our duty towards the owners of railroad property, by telling "what we know about passing," and we leave the suggestion of a remedy for the evil to their cogitations, they alone having the power, and they having full power, if they agree and combine, to abolish it utterly.

The Official Report of the Master Mechanics' Association.

In this number we begin the publication of the official report of the recent annual Convention of the Master Mechanics' Association, including the committee reports in full and the discussions as reported by the phonographer. The portion published in this number covers nearly all the proceedings of the first day, including the Report on Boilers and Boiler Materials, and the most of the long and very interesting discussion which followed the reading of that report. We will be able to give another installment of the report next week, and will publish the whole as fast as it can be prepared, and probably will complete it infrom four to six weeks.

There is probably nothing that we could publish which would be of more interest to very many of our readers than these reports; but in order that the length of these may not crowd out other important matter, we have added four pages to this number of the RAILROAD GAZETTE, increasing the amount of reading matter from ten pages to fourteen. We intend to make this addition during the publication of this report whenever necessary to give room for our usual variety.

New Railroad Legislation in Ohio.

The laws relating to railroads passed at the session of the Ohio Legislature which expired April 29, 1872, have been published in a little pamphlet of 22 pages. One for regulating freight rates is similar if not identical with that of the State of Illinois, prohibiting a charge for carrying any given distance greater than is charged by the same corporation for carrying an equal or greater distance in the same direction—that is, the minimum rate charged for any given distance is made the maximum rate chargeable for that and less distances. The penalty prescribed by the law is a forfeit to the party aggrieved of twice the over-charge, but not less than $25, and a fine to the State of from $100 to $1,000, and it is made the duty of the prosecuting attorneys of counties to bring suit for the fine, on complaint and satisfactory evidence of a violation of the law.

Another act relates to receivers of railroads, and provides that they may sue or be sued in their official capacity, that action may be brought in any county in which the road in a receiver's hands runs, and service of summons may be upon the superintendent or any ticket or freight agent acting for him; that the earnings of a road in a receiver's possession shall be applied first to pay the expenses of the suit in which he was appointed, and the expenses of working the road and liabilities incurred for such expenses; and all judgments recovered against him for injuries to persons or property, wages, work done or materials furnished, during his management, shall be a lien on the funds in his hands. Moneys coming into a receiver's hands for a line wholly in Ohio must be kept in some place within the State as the court may direct; if the road is partly in other States, a share of the funds proportional to the value of the property in Ohio shall be kept in that State.

An "act to prevent accidents by railroads" provides that every locomotive used in the State shall have a bell and a whistle, and that it shall be the duty of the engineman to sound the whistle not less than 80 and not more than 100 rods before reaching any level crossing, and to ring the bell continuously until the train has passed such crossing. Enginemen are made liable to a fine of not less than $50 nor more than $100 for every neglect to obey this law, and the company is made liable for any injury at the crossing, when there is failure to follow its provisions, and also the engineman; and the latter, in case of death or other bodily injury caused by his train at a crossing, when he failed to blow his whistle or ring his bell, is considered guilty of misdemeanor, and on conviction may be imprisoned from one to twenty months, or be fined not more than $500, or both.

"An act authorizing counties, cities, incorporated villages, and townships to build railroads and to lease and operate them" has already given a great impulse to the organization of new companies and the construction of new roads, doubtless the more so because municipal aid to railroads had been prohibited in the State for many years. The new law provides that any county may construct a railroad and borrow for that purpose a sum not exceeding 5 per cent. of the assessed valuation of its property, which sum must cover its total indebtedness incurred for railroads, and not more than one-fifth of that amount may become due and collectable in any one year. Whenever one hundred tax-paying electors of a county shall request it, the County Commissioners shall order an election to decide whether the construction of any proposed road shall be undertaken. The request must specify the termini of the road, the amount to be appropriated, and the conditions, rate, time of payment, etc., of the loan. Only one such election can be held in any one year. If two-thirds of the votes are in favor of making the loan, the county must issue its bonds, bearing not more than 8 per cent. interest, within sixty days, payable at the county treasury or in New York, which must not be sold at a discount. When issued, the county bonds are to be deposited with the State Treasurer, who will keep them until the County Commissioners present an order for them, with a certificate from the Chief Engineer of the railroad approved by them of the amount of work done and materials furnished according to the contract for construction, upon which the State Treasurer will deliver bonds to the value of 85 per cent. of the work done, until the work is completed, when the 15 per cent. withheld will be delivered. These bonds must be paid out for construction by the State Treasurer within three years of the time he received them, or they will be cancelled. The county issuing such bonds is instructed to collect taxes sufficient to pay the interest and principal when due, and such bonds are made a legal and valid charge on all its taxable property.

Within thirty days after an election which has resulted favorably, the County Commissioners are to advertise in the county for proposals for the construction of the proposed road, and are to let the contract to the lowest responsible bidder, "or to the party that will agree to build the greatest number of miles of road for the sum appropriated." Authority is given for the condemnation of property, etc., by the county, as in the case of corporations. The Commissioners are authorized to receive donations of land, money and other property in aid of the road. They are also authorized to lease the road constructed under the provisions of the act *before or after its completion*, for a term of years, to any person or company, which lease must be ratified by a vote of a majority of the electors of the county, at a meeting called for the purpose.

The provisions of the act are extended to other municipalities than counties—cities, incorporated villages and townships; and if they fail to pay interest or principal of bonds they have issued for this purpose, the County Commissioners are to levy a tax for this purpose and collect it of the delinquent municipalities with the other county taxes.

A new act prescribes the method of assessing and collecting compensation for property appropriated for the use of corporations. By this, when corporations are unable to agree with the owners of property which they desire to appropriate upon the compensation, or are unable to find the owners, they must make a petition to the Probate Judge of the county in which the property is situated, with a specific description of the property and the rights in it sought by the corporation. The Probate Judge thereupon will summon the owner and inquire into and decide upon the right of the corporation to appropriate the property, and its inability to agree with the owner, and the necessity of the appropriation. Should he find in its favor, he will summon a jury to estimate the value of the property taken and the injury done to the other property, irrespective of any benefit to be conferred by any improvement proposed by the corporation. There are to be but one petition and one proceeding, though several parcels of property and owners are named, but each owner is entitled to a separate trial. An appeal may be had from the decision of this court, but the corporation, having deposited with the court the compensation awarded, may enter upon the property notwithstanding the pendency of the appeal.

An amendment to an old law has been made which provides that when a terminus of a road described is on the State boundary, it shall be a sufficient definition of that terminus to name the county in which the terminus is to be, and that a change of the terminus to an adjoining county may be made by vote of the stockholders.

Another amendment provides that any railroad company which has been organized for a period of three years may be dissolved by a vote of two-thirds of the stockholders, provided provision be made to pay its debts, and also provided that the construction of the road, if ever commenced, shall have been abandoned for three years.

Another amendment to an act extends generally, for five years, the time for the completion of all railroads which may have been begun in good faith and have not been completed. This provision does not extend to companies that have completed a portion of their road and have abandoned work upon the remaining portion authorized for ten years previous to the passage of the amendment, nor to any company, its assignee or lessee, which shall have partly constructed a portion of its road but completed none of it, and has done no work towards completion for fifteen years.

Another act is amendatory of the general act providing for the creation and regulation of incorporated companies. It provides that a railroad company may construct a railroad between points named in its certificate of incorporation, and that it or any company may construct branches from the main line to other towns in the counties through which the main line passes, or to a connection with any other railroad in the State, which seems very much like saying that any railroad company may build a railroad anywhere in the State.

SOME time last winter a resolution was introduced into Congress asking an investigation into the disposition by the Northern Pacific Railroad Company of the money received for its bonds. Not a great deal of noise was made about the complaints, and some suspected that it was all a shrewd dodge of the company itself, intended to secure a very neat advertisement through the report of a committee which would hear no complaints, or only frivolous ones, and would have abundant testimony on the side which would help the company to credit. Just at the close of the session the newspapers very generally published a report, or an abridgment of one, which was all that the company could wish, except, perhaps, that it read very much like one of its own ingenious advertisements, such as leading religious and other journals publish with their news and miscellany for the edification of their readers—and a consideration of a dollar a line or so.

This seemed to confirm the impression that the investigation was procured by the company itself; but since the publication of this committee report a representative of the complainants has spoken out in a letter, in which he makes some remarkable statements. It appears that the complaint was made by certain bondholders who charge that the company has been paying out the proceeds of its bonds for the St. Paul & Pacific Railroad and other property, which are not mortgaged to secure the bonds. The representative of these complainants, whoever they may be, says that it was agreed that notice should be given by the Pacific Railroad Committee of a time for hearing the complaints; that no such notice was given; that, on the contrary, a report favorable to the company was drawn up and presented to the members of the Committee with a request for their signatures; that these members refused to sign such a report before hearing the complainants; that then the Committee was asked to have 25 copies of the statement of the company's directors printed for the use of Congressmen only, and that they consented to this; that then the Committee adjourned, with the understanding that nothing should be done until the next session of Congress, and that most of the members went home. Meanwhile, in the hurry of the closing hours of the session, the favorable report was presented by Mr. Sypher, of Louisiana, and is now serving its purpose as an advertisement of the company's securities. "If which things are so," there is room for sundry reflections, which will probably suggest themselves without any of our help.

THE PULLMAN PALACE CAR COMPANY has recently fitted up at No. 287 Broadway, New York, at the southwest corner of Reade street, opposite Stewart's down-town store, an office so elegant in its fittings and furniture that one is led to suspect that the company intended to see if it was possible to equal the luxury of its cars in a room not on wheels. On the whole, we think it has succeeded. Certainly, if there is anywhere a more elegant railroad office, we do not know where to find it. It is occupied by Mr. George M. Gray, a well-known Chicago railroad man, and admirably qualified by character and experience for this service, who is the general agent of the company for the city of New York. Here one may purchase a ticket for a single berth or more in a car on any of the lines on which these cars run regularly in the United States—that is, on most of the leading lines; or he may engage a car or a train of cars, a true traveling hotel, with drawing-room, sleeping apartments, dining-room and kitchen, and a corps of trained servants, in which he and his friends may travel at their leisure and at their pleasure over most of the United States and a part of Canada, switching off at any romantic (or other) spot that may strike their fancy, and finding there, however desolate, the first-class hotel accommodations that they brought with them. Just at this period, for instance (the thermometer on the writer's desk indicates 96 degrees above zero), should such a party happen to run over some snow-clad mountain in the Rockies or Sierras or elsewhere (if anywhere there be snow-clad mountains, which we feel inclined at this moment to deny), we can imagine them ordering their car or cars upon a siding, and employing themselves at snow-balling, coasting, skating, and similar amusements for a few days or weeks, as the case might be, until "Old Probabilities," by special telegram, should notify them of a fall in the temperature in the lowlands.

It is true that it costs something to travel in this way; but then it costs something, and sometimes quite as much, for a large party to stay (and swelter) at a good summer hotel, where you can't run away from the weather and take your hotel with you to the hunting and fishing grounds, the breezy plains, or the cool mountain tops. Those who are oh'ing for a lodge in some vast wilderness, to escape from these tropic heats, have now only to go to Mr. Gray in New York or the general office in Chicago, engage their "lodge" and go with it to the vast wilderness of their choice—provided that it is on a railroad.

THE DEVIL is never quite so black as when he is engaged in putting obstructions on a railroad track. One of the most infernal of the attempts of this kind occurred recently near Springfield, Ill., when, after the adjournment of one of the political conventions, a train loaded with about five hundred passengers and going at full speed came upon an obstruction formed of ties spiked to the track and piled up, which was discovered so late that with engine reversed and air brakes sprung, the engine yet tore up two or three of the ties before it came to a full stop.

It is not easy to conceive of an adequate punishment for such an offense, and it is hard to believe that there exists in human beings such devilish malignity as would deliberately plan the cold-blooded murder of men, women, and children who cannot possibly have even provoked their murderers. We can understand how wreckers might lure a vessel to destruction in order to make salvage on its cargo; but that men should wreck a train of passengers simply for the sake of the slaughter would be beyond belief were it not proved true.

As there can be no crime equal to this in heinousness, so when detected it should receive the severest punishment known to the law, and no labor or expense should be spared to discover the perpetrators. It seems to us that the railroad companies could well afford to make common cause in such a case and make sure of bringing the criminal to justice at any expense. There have been not a few similar cases, though scarcely any which threatened such awful destruction; and it would be an edifying example if the criminals were put beyond further mischief, and men like them taught that all the power and influence of the united corporations of the country will be exerted to bring such fiends surely and speedily to punishment.

THE CHAIRMAN of one of the leading railroad companies of British India, at a recent meeting of the company, said that he was glad to say that the pilgrims, both Hindoo and Mahomedan, who used to travel along the road with peas in their shoes, had found out the superior advantage of traveling by the company's railway. We imagine that if discomfort is what those pilgrims are seeking, they might find on some of the emigrant trains in this country which carry passengers from the seaports to the West, especially in these hot days, enough to satisfy the

devoutest Brahmin. We can fancy a train-load of them deliberately leaving their hard benches without backs and the stifling and crowded boxes in which they are penned, slipping into their shoes (if they wear shoes) the biggest and hardest marrowfats, and resuming their journey on foot with smiles of relief. There are methods of traveling more uncomfortable than walking, even with peas in one's shoes.

THE MASTER CAR-BUILDERS' CONVENTION was reported somewhat imperfectly and too concisely in the RAILROAD GAZETTE of June 22. We have now the full report, revised by the Secretary of the Association, which we hope to find room for next week. One very good thing done we desire to call attention to now, and to commend to all similar societies and associations, and that is the change of name from the unwieldy, unspeakable, unrememberable and altogether undesirable "United American Railway Master Car-Builders' Association" to the short, sensible and sufficient "Master Car-Builders' Association." We say sometimes that if you give a man rope enough he will hang himself, and it is to be feared that some societies take so much name that it stifles them. The master car-builders' organization was altogether too useful and promising to be so encumbered, and we are glad to see that it now has a name which one can speak without a waste of time and write on a single sheet of paper.

Contributions.

NOTES ON THE MANAGEMENT OF AMERICAN RAILROADS.

BY A HINDOO.

[Continued from page 190.]

LIMITATION OF LIABILITY.

Lately a stock-dealer sued the Lake Shore & Michigan Southern Railway Company for a considerable sum, damages on a consignment of stock shipped over that route, caused by one night's detention on the road without food and water, in consequence of which he alleged a loss, on arrival at market, of 40 lbs. weight per head. Although the corporation showed that the detention was unavoidable, and that the rest of the journey was performed with the usual dispatch, and that according to the contract they had provided a free pass for a person to accompany the stock and take care of them, who was not with the train as he should have been, the lower court decided against the company in the full amount claimed. The corporation has now appealed from this decision, reported in Detroit *Tribune*, May 16, on the grounds that their charter exempts them from a common carrier's liability in regard to stock, and contributory negligence of shipper in not sending a man along with the cattle, who should have seen them fed and watered. In the court of first hearing it was decided against the company that the limitation of liability printed on the bill of lading and stock-pass was null and void. This is the general view of the law, that common carriers cannot curtail their responsibility by any act short of an express contract and for consideration. Now the giving of a pass to men in charge is undoubtedly a consideration, but it is not generally made to appear so in the contract. It would be well if all railroad companies would agree to insert in stock contracts a clause reciting that "in consideration of a reduction from the usual rate of $— (*fare of drovers*), it is agreed that —— (*shipper*) shall send with the stock one of his servants, whose duty it shall be to see that the cattle are properly fed, watered and otherwise taken care of, and that the —— Railroad Company shall not be held liable for any loss or damage, except such bodily injuries as shall be caused by train accidents, beyond the cost of feed given to the cattle when detained on the road for the convenience of the —— Railroad Company. It is also agreed that the drover in charge of the cattle shall give notice to the conductor of the train, whenever he considers it necessary that the cars should be shunted off to allow of time for feeding, watering, or for rest."

A clause to this effect would make lawful and expressed an understanding which is now unlawful, but tacitly agreed to at the time and repudiated when convenient, as shown by the case above referred to.

The published rates for stock must then include the fare of drovers, which would be charged in full if the shipper refuse to sign the limited contract. A common carrier cannot refuse to receive freight tendered him on account of its perishable nature, but must protect himself by charging rates according to the risk.

The clause suggested, it is true, may be objected to by shippers as protecting the railroad company from the consequences of unusual, negligent or intentional detention to the stock *en route*, resulting in loss of market, but the objection carries little weight. It is almost impossible in contracts of such a nature to declare what shall be avoidable and what unavoidable. Shippers have sufficient guarantee that no avoidable detention will occur, in the fact that the traffic is so valuable to the railroad companies that the greatest care is taken by managers to gain a reputation for attention to that part of the business. No road can afford to neglect it. For the same reason no claim for actual loss on account of avoidable detention would be rejected, and a remedy in case of intentional delay, if such be possible, can be found in any court, despite the contract.

It is time that managers look the question of liability square in the face. If a printed notice or warning to shippers and the public in general cannot limit the extent of liability, to continue such notices is childish and immoral. For instance, one corporation gives notice that it "will carry 100 pounds baggage per passenger free, and in consideration thereof limit their liability to $100." In this notice we have, first, a false statement, and, secondly, an assumption of power which the corporation does not lawfully possess. The baggage is not carried free, as the charge for it is included in the passenger's fare, all that the notice may say to the contrary notwithstanding. The corporation has no power to limit the extent of its liability, as was shown not very long ago when $5,000 was given by a court in the case of a traveler whose trunk, containing jewelry, etc., was lost. If railroad companies have no power to limit their liability by such notices, the publishing of them is immoral, and an immorality done for a very small consideration. It is the policy of the huckster or the peddler who trades upon the ignorance of the person dealing with him. The poor man who has sustained what is to him a very great loss is deceived and baffled by a reference to the printed notice. The rich man, whose loss is but trifling comparatively, is either paid at once or retains a solicitor to arrange the matter. The same company referred to above also notifies passengers that they "*must attend to the* MARKING OF THEIR BAGGAGE, *and claim it immediately on arrival at destination.*" The passenger knows as much of the marking as he does of Hebrew or antediluvian hieroglyphics; how can he attend to it? And if he do not claim it immediately on arrival at destination is the company relieved from responsibility? Not by any means.

Many railroad companies have seen the absurdity of attempting to arrogate impossible powers and have eschewed the policy of deceiving the unwary by notices and such devices. Many of them rather than go into court pay claims almost too readily. Possibly on those roads which continue the practice it is more a clinging to tradition of past powers than a settled policy of the present managers, who perhaps have not given the subject the consideration it merits. In the early days of railroading the public were, no doubt, often treated harshly and imperiously, and submitted quietly because they knew no remedy. By degrees it has become manifest that the courts of law are firmly opposed to the assumption of extraordinary powers. Decision after decision has been given against the companies, each one apparently widening and extending their responsibility, until at last it is evident that the harshness and imperiousness are now all on the other side, and railroad companies are exposed, without any real remedy, to vexatious litigation. Excessive damages are frequently given; for example, $8,000 given to Peck at Norwich, $3,000 to Palmer, who was put off a train when attempting to ride on an expired-date lay-over pass. Lately a verdict was given against the Grand Trunk Railway Company of Canada for value of a valise which a passenger said was stolen from the waiting room where he had left it.

It would be well if the relations between the public and railroad corporations were placed on a better footing, being removed from the undefined region of common law to the daylight of a statute. It could not be a hardship to travelers if the liability of companies for loss of baggage were limited to say $100, provided they be compelled to carry and accept the risk of all baggage tendered them at the valuation of the passenger, charging an *ad valorem* rate therefor. Such a system of

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would be fair to all parties. I would even extend the principle to personal accidents, limiting the company's liability to say $1,000 for death or total disability and five dollars per week for partial disability, unless the traveler call upon the company to take him at his own valuation and pay an enhanced rate accordingly. A plan such as this is feasible and would save much litigation. If all the managers combined to take this in hand, legislatures could hardly refuse to pass the necessary laws. Legislatures have limited the rates which railroad companies may charge. Surely, then, they are bound to limit the liability. There may be difficulties in the way of passing such a law, but none that are insurmountable. Its justice and utility are self-evident. I recommend this subject to the attention of the Western and Southern Railway Association. If there is any reason or justice in compelling railroad corporations to make a uniform charge for passengers and luggage, and to pay fancy sums for damages done accidentally to either, valuing one man at $2,000 and another at $20,000, I do not see why the same principle is not applied to insurance companies, who should then be compelled to charge a uniform rate and pay according to the fancy valuation of the next of kin. The principle involved in the one case is exactly the same as that in the other. It may be argued that, to the insurance companies, death is certain sooner or later, according to natural law, but that to the railroad companies it comes only through their own acts. All that this objection amounts to is that the railroad companies can afford it, and should accept a lower rate of insurance; and the fact is that if every traveler insured according to the law I suggest, the rate would be extraordinarily low. For instance, take a high average of accidents, one in 300,000; every passenger could be insured for $30,000 for the small sum of *ten cents*. A rate of *five cents* for $5,000 would pay the companies handsomely.

In the freight department rates are charged according to the value of the article carried, but as luggage the companies carry the most precious articles at the same rate as the most worthless. It is reported that one of the Eastern companies is about to be sued for $100,000, as the value of some ancient lace, the heirloom of a noble family, which was part of the contents of a trunk that has gone estray. It has been decided over and over again that jewelry may be personal luggage. No doubt the idea of the judges learned in the law is that heavy damages are not to be regarded merely as compensation to the injured individual, but also be looked upon as penalties inflicted on wrongdoers. In theory such reasoning may do very well, but in practice the fear of damages does not deter companies from recklessness. It is the fear of losing traffic that operates most efficiently; for loss of prestige and reputation involves far heavier pecuniary loss than a few isolated cases of damages. If penalties are necessary or desirable they should be fixed, and the acts incurring them well defined, not left to the dishonesty of any man who chooses to swear falsely and to the caprice of a judge.

Since writing the above notes on "luggage claims" I have come across a decision of a Canadian Court of Queen's Bench which illustrates the remarks.

The case was tried at Toronto in the Queen's Bench before a jury and three judges, and is reported as follows:

"A short time back an immigrant sued the Grand Trunk Railway Company for value of contents of one out of four trunks which he had shipped from Montreal to Toronto by that road, and left at the Toronto station for several hours while he strolled over the city to pass the time until the Great Western train for Hamilton should start, as he purposed passing on to that city; but on returning to the station it was discovered that one of his trunks had disappeared. He brought evidence to prove that among other things the missing trunk contained ninety dollars worth of wearing apparel, a gold Albert chain, a lady's gold chain, a rifle, a revolver, a sewing machine, and one hundred dollars' worth of carpenter's tools. The Grand Trunk Railway contended that there were only three boxes, not four, and that some of the articles claimed for were not 'personal luggage,' therefore the company was not responsible for them. The jury rendered a verdict against the company for $300, subject to reduction by the judges of value of what they might consider not personal luggage. After hearing argument, the bench decided that the rifle and revolver were personal luggage, but the carpenter's tools and sewing machine were not. A concertina unhappily caused discord in the court, as one of the judges wished to include it as privileged; but the other two, less devoted to harmony, decided that it was not. The Bench also decided against the further contention of the Grand Trunk Railway that because one article in the box was not 'personal,' therefore they could not be held responsible for the remainder, even though belonging to the favored class."

Here we have a man who, having finished his journey and taken over his luggage, afterward concludes to leave it at the station while he rambles up town. What remedy has the railroad company? They make no charge for storage, are not consenting parties to the leaving of the luggage at their station. The man walks off, leaving the trunk on their hands against their will, and the law holds them responsible for its safety. Clearly, had they refused to store it and had thrown it off their premises, they would not have lessened their liability, perhaps would have aggravated it. If this is justice, what in the name of wisdom is unjust? Admire also the wonderful classification of privileged and non-privileged articles. The passenger is a mechanic; his tools and his sewing-machine are absolutely necessary to his livelihood. Without them he cannot obtain employment or means of support for himself and family; yet the sages of the law decide that it is not requisite for them to accompany the passenger; but behold the deep, searching wisdom of the "Blind Goddess." The mechanic cannot exist without his rifle and his revolver, and the jewelry he and his wife should have had in their personal keeping may lie about a station at the risk of a protesting party. Is this justice and wisdom, or is it a burlesque?

Books for Field Engineers.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Among the stores of books prepared for the use of the practical railroad engineer not one is just the thing needed for constant reference by a man in charge of the construction of a "division." Not an engineer who reads this article will fail to remember the many perplexing questions constantly springing up like ghosts in his path during the first few years of his probation as assistant. In vain he turned to Haswell, Byrne, Shunk, Baker and a score of other writers. One of two things was sure to repel him: either not one word was said touching the matter of enquiry, or the solution of the problem was involved in a dozen pages of abstruse mathematical discussion.

Now I hold that a vast difference exists between a *practical* work on any subject and an *empirical* one. This is a day of popular science, and no branch of science is suffering as much from a lack of *popular, practical* text books as that of railroad engineering. I say this referring specially to the science and art of locating, setting out and constructing an ordinary railroad division, where there are no iron or stone bridges to erect, the work consisting of trestles, culverts, stock-gaps and earthwork; and it is the young engineer, taking charge of his first division, of whom I speak.

A book is needed that shall, within the compass of an ordinary pocket volume, set out in plain language, unencumbered by abstruse *formulæ*, the following matters:

1. Common-sense directions for preliminary location.
2. The best methods of running straight lines.
3. The methods of locating curves.
4. The manner of obtaining right of way,
5. The best methods of grubbing and clearing.
6. Practical method of cross-sectioning and estimating quantities.
7. Best forms for trestle-bents and the manner of billing and estimating timber.
8. Directions for the construction of cattle-guards, culverts and road crossings.
9. Manner of preparing monthly and final estimates.
10. Plain directions for locating side-tracks, etc., etc.

Works that taste of Leibnitz and smell of Napier and Des Cartes are not precisely suited to the wants or the taste of the ordinary division engineer. He asks for information couched in plain, common-sense terms. He cares little whether or not you are able to follow LaPlace through his discussions, so that you tell him what he wants to know, and tell it quickly and exactly. To him, the proper length and slope of a batter-post is of more interest and importance than what strain is calculated for any point of the girders of an iron bridge. He would rather know how to set the bents of a curved trestle than to have his head crammed with "formulæ for the superelevation of the outer rail."

I do not say that many of the works prepared for the use of the railroad engineer are not quite valuable to the engineering student; but I do say that practical men want practical books,

and will set little store by any other kind. Neither would I have it understood that I am opposed to rigid mathematical demonstration when it is absolutely necessary; but to convey a plain, accurate idea of any practical method of constructing any part of an ordinary railway requires nothing of the sort; and, while nothing can be too simply told, nothing is too simple to be told.

I give the above hints and suggestions with the hope that they may provoke inquiry and discussion for the benefit of the many field engineers who greedily devour each week the contents of this journal. This I consider of the highest importance, from the simple fact that the assistant engineer is the man who builds the railroads. He is responsible in a great degree for the stability and symmetry of the whole ground-structure. Hence the necessity of putting into his head all the *practical* information it will hold. If he is a thorough mathematician, so much the better; but, if he is not, abstruse formulæ and tiresome discussions will not mend his condition.

It may be that such a book as I suggest has been published. If so, I would like to see it. I have served in every capacity, from chain-man to chief engineer of a railroad, and have examined many volumes devoted to railway construction, but have never seen one that embodied a tolerable idea of what a *field engineer* ought to know. BLUNT.

Locating Frogs.

RICHMOND, Va., July 1, 1872.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The rule given by "G. C. B." is a very good one and has been practiced here. But it only answers for straight lines.

Mine is general, and although not mathematically true, is sufficiently so.

Please correct the typography which makes $x = \frac{\sqrt{G\ D\ n}}{n+1}$ in lieu of $x = \sqrt{\frac{G\ D\ n}{n+1}}$ the radical sign covering the whole fraction. ED. T. D. MYERS.

The Erie Railway Company vs. Jay Gould.

The Erie Railway Company has brought suit against Jay Gould, its late President, in the Court of Common Pleas of the City and County of New York, in which it claims damages to the amount of $10,000,000 for acts done and contracts made in violation of his official duties. The following is an abridgement of the complaint, which was served upon Mr. Gould and filed July 1, drawn up by the company's attorneys, Messrs. Barlow, Larocque & Macfarland, and signed and sworn to by its President, Gen. John A. Dix:

The complaint opens with a description of the road and a recital of the various acts of the Legislature authorizing the issue of stock and bonds. It then states that on the 31st of December, 1865, the total capital stock of the company was $25,105,800, consisting of $8,535,700 of preferred stock, and $16,570,100 of common stock.

An election for officers of the company was held in October, 1867, when the complaint alleges, by a liberal use of the money of the company in the purchase of proxies, John S. Eldridge, Jay Gould, James Fisk, Jr., F. A. Lane and others were returned as a board of directors. Soon after Jay Gould procured himself to be elected a director of the company, it is stated that he assisted to procure the passage of a resolution by the board for the guarantee by the Erie Railway Company of $4,000,000 of the bonds of a corporation known as the Boston, Hartford & Erie Railroad Company, which guarantee was executed to the great loss and damage of the company. The complaint next charges that, in violation of his duty as director, Jay Gould, being largely engaged in speculating with the stock of the company, caused to be issued for his own personal interest $5,000,000 of so-called convertible bonds, a nominal and fictitious sale of which was made to some confederate, who caused them at once to be converted into the capital stock of the company and sold at a price not exceeding 72½ per cent. on the par value, at which price the stock was nominally accounted for to the company. That in March, 1868, Jay Gould, in connection with certain confederates, caused certain books containing stock certificates of the company signed in blank by the vice-president and secretary to be purloined, and caused the certificates to the amount of 50,000 or $5,000,000 to be sold on the stock market and accounted for to the company at the nominal value of about 72½ per cent of the par value. It is charged that this issue of stock was made without color of law or right, and that defendant derived large profits from the transaction.

It is also charged that, in addition to the convertible bonds and stocks already mentioned, the defendant, between August, 1868, and February, 1871, caused to be issued fraudulently, for the purpose of defrauding the company, so-called convertible bonds to the aggregate par value of $38,000,000. These bonds were converted into capital stock and sold, and none of the proceeds were ever returned to the company but $3,000,000 worth, which were accounted for at 21¾ on the dollar.

In consequence of these fraudulent acts it became necessary for Jay Gould and his confederates to leave the city.

The complaint then recites the circumstances attending the flight of Jay Gould and others to New Jersey, and charges that it cost the company about $400,000, which has never been refunded. In order to return to New York, that Jay Gould applied to the Legislature for the passage of certain acts validating his former transactions, and in order to procure the passage of such acts, he paid out, as an officer of the company, the sum of $1,000,000. Before returning to the jurisdiction of the State of New York, however, it was necessary for the defendant and his confederates to compromise and settle certain suits then on foot, in one of which Frank Work was plaintiff, and in another of which Richard Schell was plaintiff, and in all of which Cornelius Vanderbilt was interested. To be able to return, it is charged that defendant paid to Cornelius Vanderbilt, in cash, for his pretended losses, growing out of the fraudulent issue of the stock of the company by defendant, the sum of $1,000,000, and also purchased from Vanderbilt 50,000 shares of the stock of the company at 70 cents on the dollar, and paid for the same 1,250 bonds of $1,000 each of the Boston, Hartford & Erie Railroad Company, and $2,500,000 in cash. The 50,000 shares thus procured from Vanderbilt were subsequently sold and no return of the proceeds were ever made to the company except to the extent of $2,500,000, that being the amount of money paid to Vanderbilt. Other sums of money were also fraudulently applied to the settlement of the pretended claims of Richard Schell, Henry Thompson and Peter B. Sweeny, amounting to nearly $1,000,000.

At the annual election in October, 1868, by many fradulent contrivances and a liberal expenditure of the money of the company the defendant procured the election of a board of directors consisting of Jay Gould, defendant, James Fisk, Jr., F. A. Lane, William M. Tweed and others, and immediately thereafter procured himself to be elected president, and made an arrangement with the board of directors, by which the management of the entire affairs of the company was left to defendant and his confederates, who constituted what was called the Executive Committee of the board.

After entering upon the presidency of the company, Jay Gould is charged with a variety of fradulent practices, among others the appropriation of money amounting to many hundreds of thousands of dollars, and also 398 bonds for $1,000 each of the Boston, Hartford & Erie Railroad Company, the same being a part of the bonds purporting to have been guaranteed by the Erie Railway Company. The defendant is also charged with selling valuable real estate in the township of Union, Hudson county, New Jersey, worth at least $775,000, to the National Stock Yards Company for the nominal sum of $525,000, and receiving in consideration a large interest in the company. Most of the contracts for the supplies of the road were made by the defendant, and it is charged that in almost every instance he derived some personal profit from them, much to the damage and loss of the company. The defendant is also charged with receiving at various times the aggregate of $500,000, in various forms, from the creditors of the Atlantic & Great Western Railway Company, for which he has never accounted to the company, and the money received from the Government for the carrying of the mails is charged to have been appropriated in the same manner. The complaint concludes with a reference to the Grand Opera House, which, it states, was purchased by the defendant and the late James Fisk, Jr., and rented to the company for $55,000 per annum. They also caused the premises to be fitted up at a cost of $400,000, all of which was to the personal advantage of the defendant Jay Gould and his confederate James Fisk, Jr.

General Railroad News.

CHICAGO RAILROAD NEWS.

Chicago, Danville & Vincennes.

This company has decided to establish its car shops at Danville.

Lake Shore & Michigan Southern.

This company put on an accomodation train on the 1st inst., to run from Chicago to South Chicago. It leaves the city at 12:20 p. m., and returns at 2:25 p. m. This has been made necessary by the growing importance of South Chicago and Cornell, where four roads centering in Chicago cross each other's tracks.

Chicago, Rock Island & Pacific.

The branch of the Chicago & Southwestern from Edgerton Junction to Atchison is now completed, being a distance of 29 miles, thus giving this road direct communication with one of the most important cities of Kansas.

Chicago & Alton.

The earnings of this road for the week ending June 23, 1872, were $95,037 97. The earnings for the corresponding period last year were $121,661.93, a falling off of $26,524 96. This has been caused by the difficulty of getting storage in this city for the grain that naturally seeks this market. To meet this difficulty hereafter, R. M. & O. S. Hough have determined to build a first-class elevator in Bridgeport, which is designed to receive grain both from this road and from the Illinois & Michigan Canal.

Chicago & Pacific.

This company begins this week the construction of the bridges which are to cross the North Branch and the canal which renders Goose Island an insular tract of land.

The company will soon undertake the work of grading the line; but will probably not let it to outside parties, as there are parties within the company prepared to do the work.

ELECTIONS AND APPOINTMENTS.

—Mr. George Barrett was appointed engineer-in-chief of the Shenandoah Valley Railroad June 11. Mr. Barrett has instructions to make a report on the resources of the Shenandoah Valley, from the Potomac to the Chesapeake & Ohio Railroad, at an early day.

—Mr. Fred. Massey has been appointed General Ticket Agent, Mr. C. V. McKinlay General Freight Agent and Mr. Charles McArthur Paymaster of the Chicago, Dubuque & Minnesota and the Chicago, Clinton & Dubuque railroads. Mr. McKinlay has been acting Freight and Ticket Agent.

—Mr. P. R. Chandler having resigned the office of President of the Union Stock Yards and Transit Company of Chicago (whose stock is held chiefly by the railroad companies) Mr. James M. Walker, President of the Chicago, Burlington & Quincy Railroad Company has been chosen in his place. Mr. Chandler is one of the directors of the Chicago & Alton Company, and was the prime mover in the late "oat corner."

—The Dallas & Wichita Railroad Company of Texas, has been reorganized, Judge Cullen, the President, retiring. The officers of the company are now as follows: J. W. Calder, President; W. J. Clark, Vice President. Directors—H. S. Ervay, J. W. Crodus, A. M. Cochran, J. B. Calder, C. Wegefarth, D. Connally.

—At the annual meeting of the stockholders of the Maine Telegraph Company, at Bangor, Me., June 26, the following directors were unanimously elected: Hiram O. Alden and W. H. Simpson, of Belfast; Albert W. Paine, J. A. Smith, Albert Hulton and William Gallup, Bangor; Bion Bradbury and W. P. Merrill, of Portland; and E. F. Littlefield, of Winterport. At a subsequent meeting of the directors, Hiram O. Alden was elected President and W. P. Merrill Secretary and Treasurer of the Board for the ensuing year.

—At a meeting of the stockholders of the St. John Railroad Company, at Jacksonville, Fla., June 21, the following directors were chosen: H. P. Skidmore, John Westcott, J. J. Daniel, A. R. Day and Manning Daniels, of New Jersey. The board elected H. P. Skidmore President, Colonel John Westcott General Superintendent and Engineer, Abm. R. Day Secretary and J. J. Daniel Treasurer.

—At a meeting of the stockholders of the Chicago, Burlington & Quincy Railroad Company, held in Chicago June 27, for the election of directors for the ensuing year, the following board was re-elected: Erastus Corning, Albany, N. Y.; John C. Green, New York; Sidney Bartlett, John W. Brooks, John A. Burnham, John N. Denison, John M. Forbes, Nathaniel Thayer, Robert S. Watson, Boston; James F. Joy, Detroit, Mich.; Chauncey S. Colton, Galesburg, Ill.; James M. Walker, Chicago.

—John N. Abbott has been appointed General Ticket and Passenger Agent of the Erie Railway in place of Wm. R. Barr, resigned. Mr. Barr has held the position for a long period, and is probably one of the best known passenger men in the United States.

—The Provisional Directors of the Interoceanic Railway Company of Canada held their first meeting June 24, and organized the Company by electing as President the Hon. D. L. Macpherson, Senator; Vice-President, C. H. Fairweather, Esq., President Board of Trade, St. Johns, New Brunswick; Executive Committee—President and Vice-President, Walter Shanly, Esq., M. P., F. W. Cumberland, Esq., M. P., and W. H. Howland, Esq. Provisional Secretary, John Hague, Esq. Provisional Directors present or represented by proxy were the Hon. D. L. Macpherson, Senator, Toronto; the Hon. Wm. McMaster, Senator, President Canadian Bank of Commerce, Toronto; the Hon. John Simpson, Senator, President Ontario Bank, Bowmanville; the Hon. Frank Smith, Senator, Vice-President Dominion Bank, Toronto; the Hon. D. E. Price, Senator, Quebec; the Hon. James McDonald, Halifax, N. S.; the Hon. John Carling, M. P., Director of Great Western Railway; David Thompson, Esq., M. P., Indiana, Ont.; F. W. Cumberland, Esq., M. P., Managing Director Northern Railway; Walter Shanly, Esq., M. P.; D. D. Calvin, Esq., M. P., Kingston; C. H. Fairweather, Esq., President Board of Trade, St. Johns, N. B.; A. F. Randolph, Esq., President Bank of Fredericton, N. B.; Thomas C. Kenney, Esq., President Merchants' Bank, Halifax, N. S.; J. G. Worts, Esq., Vice-President Bank of Toronto; the Hon. J. Thibaudeau, Senator, M. Q. L. C., Quebec; Andrew Thompson, Quebec; M. H. Cochrane, Compton, Quebec; David Torrance, Montreal; J. Thos. Molson, Esq., Montreal; W. H. Howland, Esq., President of Toronto Corn Exchange Association; Edward Russell, Esq., Manager Bank of British Columbia, Victoria, B. C.; John Starr, Esq., Halifax, N. S.

—A meeting of the provisional directors of the Canada Pacific Railway Company was held in Montreal on June 20. Sir Hugh Allan was elected President of the company; Donald McInness, Esq., Vice-President; E. Lef. de Bellefeuille, Esq., Secretary; and Hon. J. J. C. Abbott, Solicitor, and the names of the following gentlemen were added to the Provisional Board of Directors: Hon. Thomas McGreevy, Hon. John Hamilton, Hon. Louis Archambault, Wm. J. Currier, Esq., M. P., Victor Hudon, Esq., Chas. J. Coursol, Esq., Mayor of Montreal, Hon. B. Flint, Hon. J. L. Beaudry, Wm. McDougall, Esq., and Charles S. Rodier, Esq. Sir Hugh Allan and Louis Beaubien, Esq., M. P., were appointed to form the Executive Committee of the Provisional Board.

—Charles M. Bissell has been appointed General Superintendent of the New York & Harlem Railroad in place of Mr. I. C. Buckhout, who devotes himself entirely to his duties as Chief Engineer.

—At the annual election of the Rome, Watertown & Ogdensburg Railroad Company, the following gentlemen were chosen directors: Messrs. W. C. Pierrepont, Marcellus Massey, C. Zabriskie, Jr., Moses Taylor, Samuel Sloan, Wm. E. Dodge, John T. Denny, Gardner Colby, John S. Farlow, T. H. Camp, S. D. Hungerford, Theodore Irwin and Wm. W. White. At a subsequent meeting of the board the following officers were chosen: Marcellus Massey, President; T. H. Camp, Vice-President; Z. A. Sawyer, Secretary and Treasurer.

PERSONAL.

—Mr. C. F. Jauriet has resigned his position as Superintendent of Machinery of the Chicago, Burlington & Quincy Railroad. Mr. Jauriet has had charge of the locomotive department of this road for many years, during which time that department has become widely known as one of the most efficient in America. He was previously in the service of the Michigan Central. Few master mechanics in the country are more widely known, and he has always been held in high consideration by men of his profession, from which, by the way, we understand that he does not intend to withdraw permanently.

—Sir Thomas Dakin, late Lord Mayor of London, President of Great Western Railway Company of Canada, Mr. Gilson Homan, Vice-President of the same company and one of the new directors of the Erie Company, and other directors of the Great Western, have been in America a few weeks and have visited Detroit and Chicago, and been received by the boards of trade of those cities.

—Mr. I. C. Buckhout, long Chief Engineer and General Superintendent of the New York & Harlem Railroad, is relieved of the duties of Superintendent, and hereafter will be Chief Engineer only. The work of improving the Fourth avenue entrance, involving, as it does, an immense amount of engineering work, is likely to give the company's engineer full employment for some time to come.

—At a meeting of the directors of the Pittsburgh & Connellsville Railroad Company in Pittsburgh, June 20, the resignation of the President, Mr. William Oden Hughart, who has held that position for many years, and almost from the beginning of the enterprise which has been brought to completion under his administration, was submitted. In accepting it the directors passed resolutions of regret, which are exceedingly complimentary, bearing testimony to his energy, integrity and industry. Mr. Hughart goes south to take possession of the Mem-

phis & Charleston Railroad for the Southern Security Company, the lessee.

—Hon. John H. Page, Jr., for some years Secretary and Treasurer of the Pittsburgh & Connellsville Railroad Company, resigned on the 20th ult. In accepting his resignation the directors passed resolutions in which they bore testimony to "the uniform skill, integrity, worth and ability of Mr. Page, as shown in the years he has served the company."

Mr. Page goes West, where he will be connected with a new Indiana railroad.

—Mr. Samuel Smith, an agent of the Chicago & Alton Railroad in St. Louis, was married in that city on the afternoon of June 27 to Miss Alice Field, daughter of Col. A. P. Field of New Orleans. The ceremony is described in the St. Louis papers as having been the occasion of a fashionable gathering, in which many prominent citizens of St. Louis took part.

TRAFFIC AND EARNINGS.

—The earnings of the Pacific Railroad of Missouri for the second week of June were: 1872, $71,699; 1871, $63,143; increase, $8,556, or 13½ per cent.

—The estimated earnings of the Kansas Pacific Railway for the second week of June were: Freight, $48,031.19; passengers, $29,152.65; total, $77,183.84. Of this $6,721.13 was for government traffic, one-half of the receipts from which, we believe, are applied to the payment of the interest guaranteed, and for the rest paid, by the government.

—The Charleston *News*, of recent date, says: "Already Charleston, through the activity of the South Carolina Railroad, is obtaining cotton from the main Gulf ports. Since the last of March, more than *three thousand bales of cotton have come from Mobile to Charleston, en route* to New York, and several thousand bales more will pass through before the season closes."

—The corrected report of the earnings of the Pacific Railroad of Missouri for the month of May is: 1872, $269,559; 1871, $284,732; decrease, $15,173, or 5½ per cent. Our table published June 22, gave the receipts in 1872 as $265,000. The receipts of the company for the first week of June were: 1872, $62,146; 1871, $56,635; increase, $5,511, or 10 per cent.

—The estimated earnings of the Kansas Pacific Railway for the third week of June were: freight, $51,402.77; passenger, $27,841.55; total, $79,244.32. Of this, $4,619 18 was from government traffic.

—The earnings of the Pacific Railroad of Missouri for the third week in June were: 1872, $69,267; 1871, $59,385; increase, $9,882, or 16⅔ per cent

—The earnings of the St. Louis & Iron Mountain Railroad for the third week in June were: 1872, $47,167; 1871, $23,499.89; increase, $23,667.11, or 100¾ per cent.

—The receipts of the Chicago & Alton Railroad for the third week of June were: 1872, $95,036.97; 1871, $121,661.93; decrease, $26,524.96, or 22 per cent.

—The earnings of the Erie Railway for the third week of June were: 1872, $344,286; 1871, $403,440; decrease, $59,154, or 14¾ per cent. This is the first week since the new management began to make reports that there has not been an increase over last year's earnings. The gross increase since April 1 has been about $600,000.

THE SCRAP HEAP.

New York Citizens Killed on Railroads.

The report on Vital Statistics, prepared for the Health Department of the City of New York, gives the following as the number of deaths caused by the railroad lines named:

	Deaths.
Hudson River Railroad (steam), west side of island	15
Hudson River Railroad (freight), on west side of island	2
New Haven Railroad, on west side of island	7
Lines of unspecified railroads on west side of island	2
Third avenue street cars	14
Belt Railroad	9
First and Second avenue	8
Seventh avenue	5
Bleecker street	3
Grand and Forty second street	3
East Broadway and Dry Dock	3
Fourth and Madison avenue	2
Avenue C	2
Broadway	1
Sixth avenue	1
Eighth avenue	1
Ninth avenue	1
Lines unspecified	2
Hand-car	1
Hunter's Point (Long Island) street-cars	1
Steam-cars in Westchester County	2
Steam-cars on Long Island	2
Steam-cars in New Jersey	3
Total	90

This includes, we suppose, those killed within the city and those injured outside of its limits who died within the city.

"Clear Grit."

The Pottsville (Pa.) *Miners' Journal* has the following account of a case of clear grit: "Near Shamokin, on Friday evening, as an engine with twenty loaded coal cars was coming down the grade from the junction on the Northern Central Railroad, which is a single track at that point, a cow was run over. The engine kept the track, but the cars were thrown off, piled up, and wrecked. The fireman, thinking the engine was off the track, jumped from the engine, which, steam on, kept on down the grade, and passed at a rate of speed 30 or 35 miles an hour through Shamokin. In a few minutes the passenger train from Sunbury would be due, and if the engine kept on a collision would be inevitable, the results of which would unquestionably involve loss of life and property. As the coal engine with not a living soul dashed toward the scales, a young man employed there named Miles Gray took in the whole situation at a glance. As the engine was dashing past, a grasp at one of the iron supports and simultaneous spring, placed him on the engine, and he succeeded in stopping it three minutes before the passenger train came in. The act was one involving great personal risk; it unquestionably prevented a serious accident, and young Gray should receive a substantial testimonial for his bravery and the risk he ran."

The Paterson Locomotive Shops.

We learn that on the 24th instant the boiler makers in the three locomotive works in Paterson, N. J., struck for eight hours as a days work. It was understood that the molders would also strike soon, but on the 25th the works were all closed and the proprietors gave notice that they would remain closed until further notice.

Narrow Gauge in India.

At a recent meeting in London of the Great Southern Railway Company of India, Mr. G. B. Bruce, the Consulting Engineer, made the following statement:

"The Southern Extension line would go from Trichinopoly to Muniachee, branching thence to Tinnevelly and Tuticorin, a length of 216 miles. The gauge, which at first was not fixed, was now settled as the metre gauge. The original estimate for constructing the extension line was £4,617 per mile, including rolling stock, but the government authorities went over the various items in the estimate and struck out some of them on account of the line being on the narrow gauge, altering the estimate to £3,972 per mile; but it was only fair to say that this estimate did not include the great increase in the price of materials, especially of iron, that had since occurred in this country. The diminution in cost was not all due to the difference of gauge. The actual difference in cost was not so much between the broad and narrow gauge as was supposed. The broad gauge in India was 5½ feet, and the metre or narrow gauge was 3ft. 3⅜in., the difference being 2ft. 2⅛in. A third line would be laid down from Trichinopoly to Tanjore, so that there should be no break of gauge on that portion of the line, but there would be a break of gauge from Madras. They had reduced the length of platforms at stations and other works to reduce the estimate. Another matter was that there would be no fence to the narrow-gauge lines; the other lines had iron fencing. The weight of the rails was the difference in reality between the broad and narrow gauge."

LaGrange Rolling Mill.

A company known as the "LaGrange Iron and Steel Company," is constructing and has nearly completed at LaGrange, Mo., on the Mississippi Valley & Western Railway, eleven miles above Quincy, works for rolling iron and steel rails, which will be the first, we believe, west of the Mississippi north of St. Louis. There will be a puddle mill, 200 feet by 70, with six puddling furnaces, capable of turning out 10 000 pounds of puddled iron every 24 hours, two scrap furnaces, one old-rail furnace, a squeezer, break-down rolls, and a shears, with a 500 horse power engine, besides a small one for the shears; a boiler house 40 by 42, with six boilers, 48 inches in diameter and 28 feet long; a rail mill building, 90 by 238 feet, with an engine of 1,350 horse power; a building 40 by 90 for the gas producers of the Siemens' regenerative furnaces; a piling house, in which also are the cold shears; and a building 35 by 118, containing blacksmith, machine and carpenter shops, store room, pattern and brick room, with a small steam engine.

These works will have capacity for about 25,000 tons of rails yearly, and will employ 350 to 400 men. The cost is about $400,000. The estimate of materials to be used daily is 15 tons of pig iron, 25 tons of scraps, 60 tons of old rails, and 140 tons of coal.

Test of a New Railroad Bridge.

A correspondent sends us the following account of the testing of an iron railroad bridge built by the New England Iron Company, for the New York & Boston Railroad: "The test was made at the extensive works of the company at Readville, Mass., by loading the bridge with pig iron. The bridge is of the well-known principle of the Pratt truss. The clear span was 97 ft. 2 in. The main trusses are calculated to carry a load of 2,500 lbs. per lineal foot, which load, exclusive of the weight of the structure, strains no part of the main trusses more than one-fifth of its ultimate strength, and the floor systems are so proportioned that the maximum weight on the four drivers of the heaviest locomotive will strain them only one fifth of their ultimate strength. The load was put on the bridge and the deflections carefully noted. The greatest deflection with the full load was found to be ⅞ in.

"The bridge was constructed under the superintendence of E. H. Hewins, the engineer of the constructing company. All the parts *fitted* and that *perfectly*. The pins, bolts, and in fact everything about the bridge gave evidence of the greatest care in construction as well as in proportion.

"The same company have in their yard nearly completed seventeen bridges for the same road, and various bridges for other roads in different parts of the country. It has a capacity for a 100 feet span a week."

Railroad Reading Room.

We learn from the Indianapolis *News* that the agent of the Indianapolis & St. Louis Railroad has established a reading room in that company's office in Indianapolis, for the use of the employees of the road and of other railroad men. If all the railroad companies should join in such an enterprise, Indianapolis, one of the greatest of "railroad centers," might have an admirable reading room at very small expense; and there might be branches for the different places of resort, in which the costlier and rarer works might be used in turn.

Canada Car Company.

This company, recently organized in Canada, asks subscriptions to its proposed capital stock of $500,000, of $250,000, with which it is proposed to establish at Toronto, works for manufacturing passenger and freight cars, and also wheels, axles and springs. The Canada Steel Works property is to be purchased. As nearly all materials and labor also are cheaper in Canada than in the United States, and yet a large number of cars are bought annually from works in the United States by Canada railroad companies, it is thought that such works will thrive.

OLD AND NEW ROADS.

American Bridge Company.

This company, whose works, we believe, are the largest in the country, is offering in open market the balance of its $1,000,000 of authorized capital, $414,700 having been issued previously. The company announces that its profits during the year ending with March last were at the rate of more than 50 per cent. on the stock then outstanding, and says that it will be able to make from 20 to 25 per cent. dividends on the full capital. The managers of the company are very energetic men who have done an enormous business and made an excellent reputation.

Milwaukee & Northern.

This company has put on the New York market its 8 per cent. first mortgage bonds having twenty years to run, at the rate of $18,000 per mile. They are offered at 90.

New York & Philadelphia Air Line.

A telegram from Philadelphia, dated July 2, says: "Contracts were to-day given out for building the Air Line Railroad between this city and New York, passing through Bucks County, thence to Newark, and joining the Stanhope Road to New York. The road will cost $6,000,000. Work is to be commenced immediately. The route is some miles shorter than the present one, and it is proposed to make the run between the two cities in two hours and fifteen minutes. The terminus of the road here will be the Ninth and Green streets depot of the Philadelphia & Reading Railroad."

Texas Consolidation.

Announcement is made of the consolidation of the International and the Houston & Great Northern railroad companies of Texas, under the presidency of Moses Taylor, of New York.

The Houston & Great Northern previously had obtained possession of the Houston Tap & Brazoria Railroad, which extends from Houston southward 50 miles to Columbia, on the Brazos River, which, with the rest of its line now completed, makes it 146 miles long. About 100 miles of the International is completed from Hearne, on the Houston & Texas Central, northeast to Palestine, where the Houston & Great Northern will intersect it, 60 miles north of its present terminus.

The consolidated companies are offering their 7 per cent. gold bonds, limited to $16,000 per mile, at 85. The International has a subsidy from the State of $10,000 per mile, and the Great Northern a land grant from the State of 10,240 acres per mile. The office of the joint board is at No. 52 Wall street, New York.

North Pacific.

The certificate of incorporation of this company was filed in the office of the Secretary of State at Sacramento, June 22. The company propose to build a railroad from San Francisco through the counties of Marin, Sonoma, Mendocino and Humboldt, to a point in Humboldt Bay, about 203 miles; also a branch from the city and county of San Francisco, through Tiburn Point, in Marin County, to said main line, about ten miles as near as may be in the county of Marin; also a branch commencing at or near San Rafael, in Marin County, and running thence through the counties of Sonoma and Napa and into Solano County to the California Pacific Railroad at or near Jamison's Pass, a distance of about 28 miles as near as may be; also a branch from Napa City, in the county of Napa, to intersect the branch last aforesaid, a distance of about nine miles as near as may be, and wholly in the county of Napa; also such wharves and docks as may be necessary to operate such roads and accommodate the business thereof, and ferries to connect them with San Francisco. The capital stock of this company is to be $12,350,000. The directors are to be Leland Stanford, Mark Hopkins, C. P. Huntington, E. H. Miller, Jr., and Charles H. Cummings.

Brownsville, Fort Kearney & Pacific.

The contract for grading this railroad from Brownsville westward to Tecumseh, Neb., 30 miles, was let June 20 to John Fitzgerald, of Plattsmouth, Neb., who has done a large amount of grading on the Burlington & Missouri River Railroad in Nebraska.

Bachman's Valley.

The grading of this road is to be completed from its junction with the Hanover Branch road near Leib's Mill, about five miles southwest of Hanover Junction, to Chestnut Hill Ore Banks, Maryland, by the middle of August. Five miles are completed, from Leib's Mill southeast up Codorus stream to Kleinefeltersville, Pa., within two or three miles of the Maryland line. From this line the course of the road is southwest instead of southeast, the proposed terminus being on the Maryland Western at Westminster, 29 miles from Baltimore.

Ohio & Kentucky.

The Chillicothe *Advertiser* reports that this company has been negotiating with the Pennsylvania Company, and that satisfactory arrangements for the construction of the road have been made.

Frederick & Pennsylvania Line.

The track is now laid over the bridge and trestle works over Big Pipe Creek, at Bruceville, and the connection with the Western Maryland Railroad and the Pennsylvania roads is complete. The Pennsylvania Company now run their own engines over the road, and bring all the iron *via* Northern Central and Hanover Junction. The track-layers are rapidly approaching Renner's warehouse, 1¼ miles north of Woodsboro', Frederick County.

Baltimore & Ohio.

In this company's suit with the State of Maryland, the previous decision of the Court of Appeals is maintained for $350,000 arrears of State's share of the passenger moneys on the Washington Branch. The Court of Appeals affirms the judgment of the Superior Court. In the case

commonly called the "gold case," in which the Superior Court adjudged the railroad company debtor to the State some $250,000 or $260,000 in gold on account of arrears of dividends provided to pay the sterling interest of the State in London, the Court of Appeals reverses the judgment of the Superior Court, and relieves the company from this claim.

Proposed New York Railroads.

The following companies have been recently organized to build roads in the State of New York:

The Pine Plains & Albany Railroad, which is to run from Pine Plains, in Dutchess County, to Chatham Village, a distance of 36 miles. Capital, $1,600,000. This road would run very near the Harlem.

The Rochester, Hornellsville & Pine Creek, to run from Hornellsville south to the State line in the town of West Union or Troupsburgh. The road would be 23 miles long and the capital stock is $550,000.

The Cayuga Northern, 12 miles long, from Cayuga Village north to Montezuma and Port Byron. Capital stock, $200,000.

The Elmira State Line Railroad, from Elmira to the Pennsylvania State line, to connect with a road to be constructed at or near Lawrenceville. This road will be 20 miles long, and the capital stock is $600.000.

The Niagara River & New York Air-line, from a point at or near the city of Buffalo, by way of Lockport, Medina, Knowlesville, Albion, Holly, Brockport and Spencerport, to Rochester, 78 miles. Capital stock, $2,000,000.

The Rockland Central Extension Railroad, from Orangeburg to a point on the New Jersey State line near Tappantown. The capital stock is to be $20,000.

The New York & Boston Extension Railroad Company is to build a short line about five miles from a point on the New York & Boston Railroad near High Bridge, to a point at or near the mouth of Harlem River, at Port Morris. The capital stock will be $2,000,000. The proposed road will be very near the present line of the Harlem & Hudson River company's road.

The Upper Hudson Railroad Company and the Schuylerville & New Haven railroads have been consolidated under the title of the Schuylerville & Upper Hudson Railroad Company, with a capital stock of $300,000,

Salisbury & Baltimore.

This new road, extending from Meyer's Mills on the Pittsburgh & Connellsville road to Salisbury, in Somerset County, Pa, has been delayed in its completion from several causes, chief of which, it is stated, is an inability to make a satisfactory arrangement with the Baltimore & Ohio Company, in regard to freights on coal over that road from Cumberland to Baltimore, and also over the Pittsburgh and Connellsville from Meyer's Mills to Cumberland. The rate named by the Baltimore & Ohio Company is so high that it is believed that shippers of coal from the Salisbury region would be unable to compete with those in the George's Creek region. Another reason for delay is the present high price of rails. In the meantime, the managers are looking to another outlet for the Salisbury & Baltimore road, which can be had by the Buffalo Valley road, which is now being constructed from a point on the Pittsburgh & Connellsville, a short distance west of Meyer's Mills, to Berlin, Pa., about ten miles. From Berlin, connection can be made with the Pennsylvania Railroad by way of Bedford. The route has been surveyed, and it is found that a road can be built with easy grades. It is very probable that this course will be adopted.

Pennsylvania Railroad.

Beginning with July 1, this company has discontinued the sale of yearly and quarterly commutation tickets from New York to New Jersey stations. Hereafter only monthly tickets will be sold, the prices of which, with the distance of the stations from Jersey City, we give below:

Station.			Miles.	Price.
Marion			2 49	$3 75
Newark			8.75	6 00
Waverley			10.96	6 50
Elizabeth			13.63	7 00
Linden			16.84	7 50
Rahway			18.89	8 00
Avenel	Perth Amboy Branch			8 50
Edgar's				9 00
Woodbridge				9 50
Spa Spring				10 00
Perth Amboy				10 50
Houtenville			21.00	8 50
Uniontown			22.18	9 00
Menlo Park			23.43	9 50
Metuchen			25.80	10 00
Stelton			28.00	10 50
New Brunswick			30.75	11 00

These tickets, it must be remembered, include the ferriage between New York and Jersey City. These rates are a little higher than the old rates for yearly tickets, but lower than those formerly charged for quarterly tickets. The company have also begun the sale of what are called "50-trip family tickets." These are sold between any two stations on the line, good for 50 trips, and differ from the commutation tickets, which are not transferable, in that they can be used by any member of the family, servant or visitor of the purchaser. They are sold at the rate of two cents per mile.

Freight for the Philadelphia, Wilmington & Baltimore Railroad will hereafter be received at Pier 39, North River, New York.

Atlantic & Pacific.

There are reports in St. Louis that this company and the Pacific of Missouri, which for some time have been worked together with one General Superintendent, are to be consolidated. Within a few weeks the stock of the Pacific of Missouri has advanced from 90 to 110. Less than forty miles of the Pacific of Missouri is used by the Atlantic & Pacific, from St. Louis westward.

Ohio & Mississippi.

This company was prepared, July 1, to pay off the first mortgage of $3,600,000.

The East River Bridge.

There having been charges that those in charge of this bridge were making it cost extravagantly through corrupt contracts, etc., Mr. Washington Roebling, the Chief Engineer, has reported to the directors that he is familiar with the terms of all the contracts, and believes them to be as low as practicable, and that the work has been conducted with economy. He says, however, that the work so far as done has cost much more than was estimated originally by the designer of the bridge, the late John A. Roebling, the work now completed, which was estimated to cost $1,412,260, having cost actually $2,759,155; but this is caused partly because the structure has been made larger than the original design, and partly because of the very great cost of some of the work for which there was no precedent—the excavation on the Brooklyn side having cost $4.50 per yard, instead of $1, as was estimated. Colonel Roebling has revised the total estimate made by his father, and makes the total probable cost of the bridge $9,500,000, instead of $7,000,000.

Fort Wayne, Adrian & Detroit.

A correspondent writes that this company has now in course of construction in Michigan, the section between Adrian and Saline, a distance of 28 miles, under contract to James Berry, which is nearly graded. The company has charters for a line from Saline, Mich., to Kokomo, Ind., where it is intended to connect with the new Logansport, Crawfordsville & Southwestern road, which will complete a line to Terre Haute, whence the "Vandalia Line" will give a direct connection to St. Louis. From Saline the eastern outlet is the Detroit, Hillsdale & Indiana road to Ypsilanti, and the Michigan Central to Detroit. This would form a very direct route from Detroit to St. Louis.

Mansfield, Coldwater & Lake Michigan.

The machine and repair shops of this road have been located at Coldwater, Mich.

Portland & Ogdensburg.

The city of Portland voted, June 25, against the proposed loan of $1,350,000 to this road. A second trial is to take place in a week or two.

Lee & New Haven.

At a meeting of the directors of this company, at Pittsfield, Mass., June 24, the individual subscriptions made in that town were withdrawn, and Mr. Colt, the President, resigned. Pittsfield having thus given up her interest in the road, it becomes certain that Lee will be the northern terminus. The building of the road will be commenced by Willis Phelps, of Springfield, Mass., in August.

Connecticut Western.

The city of Hartford has decided to keep its stock in this road, and is anxious for the construction of the New Britain & Farmington Branch.

Dividends.

The Southern Railway Security Company pays a half-yearly dividend of 3½ per cent. at the office of M. K. Jesup & Co., No. 59 Liberty street, on and after July 15.

The Delaware, Lackawanna & Western pays the usual quarterly dividend of 2½ per cent. on and after July 20.

The Paterson & Hudson River Railroad Company pays a half-yearly dividend of 4½ per cent. at the office of the Rogers Locomotive Works, July 3.

The Stonington Railroad Company pays a quarterly dividend of 2½ per cent. at M. Morgan's Sons, No. 39 William street, July 10.

The Second Avenue Railroad Company, of New York, pays a quarterly dividend of 2 per cent.

The Hartford & New Haven Railroad Company began paying a quarterly dividend of 1¾ per cent. on the scrip stock, and 3 per cent, on the full stock, July 1, at Hartford and at the Union National Bank, New York.

The Erie Railway pays a half-yearly dividend of 3½ per cent. on the preferred stock, July 15.

Wells, Fargo & Co. (express) pay 3½ per cent. July 5.

Winslow, Lamier & Co., No. 27 Pine street, New York, paid the guaranteed quarterly dividend of 1¾ per cent. on the stock of the Pittsburgh, Fort Wayne & Chicago Railway, July 2.

The Paterson & Ramapo Railroad Company began paying a dividend of 2 per cent. July 3.

The Rome, Watertown & Ogdensburg pays a half-yearly dividend of 4 per cent. July 15, at Watertown and the Mercantile National Bank, New York.

The Lake Shore & Michigan Southern makes a semi-annual dividend of 4 per cent. August 7 on the common stock, and a dividend at the rate of 8 per cent. per year on the installments paid in the scrip certificates. Books closed July 6 and re-open August 15.

The Illinois Central pays the usual half-yearly dividend of 5 per cent. August 1.

Cincinnati & Newport Bridge.

This new railroad bridge over the Ohio was opened for foot passengers June 30.

Cincinnati & Springfield.

Trains began to run regularly on this railroad, usually known as the "Short Line," July 1.

Lee & Hudson.

The directors of this company, at their meeting on June 24, awarded the contract for building that part of their road between Glendale and West Stockbridge to Kelly & Adams, of Poughkeepsie, N. Y., who are to begin work July 9, and are to have the grading completed, ready for track laying, by next April.

Boston & Maine.

This company has asked the Supreme Court of Massachusetts to grant an injunction to restrain the Eastern road from taking land on Causeway street, Boston, belonging to the former, the right to which for terminal purposes was granted the Eastern road by the last Legislature.

Boston, Hartford & Erie.

In April, 1869, the Adams Express Company made an agreement with the officers of the above named corporation by which they loaned them $200,000, and in return the railroad corporation were to give the express company exclusive express facilities until the debt was paid. When the receivers took possession of the road they refused to carry out said agreement, and the express company gave a bond, holding themselves liable for the earnings in case the decision of the the court should be against them. When the trustees appointed under the Berdell mortgages took possession, they also refused to execute the contract, and similar stipulations took place. Now the decision of the Supreme Judicial Court of Massachusetts hasbeen given, and it is adverse to the express company, the court holding that the receivers and trustees were not obliged to carry out the said contract, and order that the Adams Express Company account for the earnings subsequent to October 20, 1870.

Ware River Railroad.

This company, the Springfield *Republican* reports, has not yet paid the interest on its bonds, due June 1, and the northern extension still remains unfinished.

Mount Washington Railroad.

This company, it is reported, made a profit of 10 per cent. last year, which, however, was not divided, but invested in additions to the rolling stock.

Boston & Albany.

Hawkins & Burrall, of Springfield, Mass., have contracted with the Boston & Albany Railroad Company for their proposed machine shop, 400 feet long by 113 feet wide, to be located near their engine house on the island at East Albany. The same parties have contracted for the erection of the new freight house to be built in Springfield east of Chestnut street.

Sodus Point & Southern.

This company opened the first section of its road, from Newark northward to Sodus Centre, N. Y., ten miles, June 26. Six miles more will complete it to Lake Ontario at Sodus Point.

Buffalo, New York & Philadelphia.

This road is now completed as far as Olean on the Erie Railway, the last rail having been laid about two miles south of Ischua, June 26. Regular trains were to commence running July 3.

New York & Canada.

The Delaware & Hudson Canal Company advertises for proposals for the graduation, bridging, masonry and fencing of this road, from Whitehall along the west side of Lake Champlain to Port Henry, N. Y., a distance of about 38 miles. The line will be divided into sections, and the maps, profiles, specifications and plans can be seen after the 6th at the office of the Chief Engineer, C. W. Wentz, in Whitehall, to whom also proposals may be addressed until July 16.

New Jersey West Line.

It is now reported that this road will fall into the hands of Delaware, Lackawanna & Western and the Central of New Jersey combination.

Ashtabula, Youngstown & Pittsburgh.

The contractors on this road, Messrs. Manners, Moore & Co., have opened their office at Warren, and work was begun last week all along the line from Niles to Bristol.

Painesville, Youngstown & Pittsburgh.

This road having passed into new hands, an effort is being made to get an extension of the time for the completion of the road. Eight months is the time asked for.

Cleveland, Mount Vernon & Delaware.

This road was completed to Mount Vernon June 25, and was opened the same day by an excursion from Cuyahoga Falls to Mount Vernon.

St. Paul & Pacific.

The first train crossed the new railroad bridge at St. Cloud, June 19

Cleveland & Mahoning.

Notice is given of a meeting of Stockholders, to be held at Cleveland, July 25, to consider agreements of consolidation with the Niles & New Lisbon, and the Liberty & Vienna railroad companies. Meetings of the two latter companies are also called, to be held in Niles, July 26, for the purpose of considering the same agreements.

Great Western of Canada.

This company invites proposals for 75 oil-tank cars, platforms with iron tanks, plans and specifications for which may be had of Mr. W. A. Robinson, the Mechanical Superintendent at Hamilton, Ont. Tenders will be received by the Treasurer, Mr. Joseph Price, down to the 18th of July.

Owensboro & Russellville.

The Chattanooga *Times* says, that this road in connection with the Cumberland & Ohio and St. Louis & Southeastern roads, proposes to build a branch from Gallatin to Chattanooga, making the most direct route from St. Louis to Chattanooga. Surveys have been already commenced.

Lafayette, Bloomington & Mississippi.

This road was to be opened for business on July 1. The equipment is put on, and the road run by the Toledo, Wabash & Western Company.

Sullivan, Moawequa & Roodhouse.

The survey of this road, which is to run nearly due west from Sullivan in Moultrie county, Ill., to Roodhouse, is completed.

Danville & Gilman.

An engineering party under charge of Captain Fitch, of the Danville & Terre Haute Railroad, are surveying a line from Danville to Gilman, on the Illinois Central.

Toledo, Peoria & Warsaw.

The Gilman *Star* of June 22 says: "We understand that the Sheriff of Ford County, under a Treasurer's warrant, took possession of the stock train on this road on Wednesday, soon after it entered Piper City. The execution calls for about $2,400 money, due State and county for taxes. The conductor of the stock train begged off, and told of other trains approaching that contained no live stock, and they would not suffer so

much by detention. The Sheriff opened his heart and let him go. On the train's arrival here the conductor telegraphed to headquarters the circumstances, and orders were sent over the line that no trains should stop at Piper at present. The company does not refuse to pay the taxes, but says the amount is too great."

Warsaw & Rockford.

In the United States Circuit Court at Chicago, June 26, in a case of William L. Scott against the Warsaw & Rockford Railway Company, decree passed in favor of complainant for $190,651.40, as well as for $5,000 solicitors' fees. This was a bill to foreclose first-mortgage bonds of the company dated July 1, 1860, re-docketed. The case had been in court some six years. As to the solicitors' fees no personal judgment was entered, it being the understanding that the amount is to be made by a sale of the property.

Missouri, Kansas & Texas.

A difficulty has arisen between this company and the people of Fort Scott. It seems that some time since the county voted bonds to the railroad, on condition that the end of a division of the road and the principal repair shops should be located at Fort Scott. It is now claimed that the company has violated its agreement by building machine shops at Parsons. The County Commissioners have ordered the payment of interest on the bonds to be stopped.

Havana, Mason City, Lincoln & Eastern.

A proposition having been made to consolidate this road with the Monticello Railroad, and then sell the whole to the Indianapolis, Bloomington & Western Company, special town meetings were held, June 17, in the towns of Pennsylvania, Sherman, Havana and Mason City, in Mason County, Ill. The vote in all these towns was against the transfer.

Pana, Carlinville, Carrollton & Clarksville.

A correspondent of the Missouri *Republican*, writing from Jerseyville, Ill., says: "The injunction suit commenced by citizens of Greene County to restrain the County Court of that county from issuing the $200,000 voted to the Pana, Carlinville, Carrollton & Clarksville Railway to the Springfield & Carrollton Railway, has been settled by the Court being enjoined from appropriating or diverting directly or indirectly any part of the bonds voted to aid the Springfield & Carrollton Company; and no bonds are to be delivered or paid over to the Pana, Carlinville, Carrollton & Clarksville Railroad until the railroad is completed through Greene County, and then not until the Court shall give at least twenty days' notice in some paper publish in Greene County, setting forth the amount of bonds the person or corporation to whom it is the intention to deliver the same, and on what account; and the Court is further enjoined not to cause to be engraved or printed any of said contemplated bonds at the expense of the county until the same shall have become due, or some part thereof."

Greenville & Columbia.

A meeting of all the bond-holders of this road, except those holding first mortgage bonds, was called for at Columbia, S. C., June 19. Only about one-third of the bonds was represented, and the meeting, after some discussion, appointed a committee to consult with Wm. J Magrath, President of the company. Provision was made for another meeting to be held at an early day.

St. John Railroad.

At the recent annual meeting of this company, at Jacksonville, Fla., it was decided to improve the track by relaying it and strapping it with iron. It was also resolved to purchase locomotives suitable to the road. The rails now used are of wood and the motive power furnished by mules. The line is from the St. John River, at Tocoi, to St. Augustine, Fla.

Nashville & Decatur.

This road was turned over to the Louisville & Nashville Railroad Company July 1.

International and other Texas Railroads.

An officer of this company writes to us as follows of this road, dating from Hearne, Texas, June 25th. "To day we have 95 miles of iron down; there will be 100 by the time this reaches you. We shall open to Palestine, July 10, and will then run regular schedule trains. Our crossing of the Trinity River has delayed us four months. You can appreciate the magnitude of the work from the following: 2,700 cubic yards of masonry; 1 draw span, *all iron*, 250 feet; 1 fixed span, Post combination, 250 feet; about 6,000 feet of trestle work, ranging from 24 to 33 feet in height. Total cost about $250,000. The grading is nearly complete 60 miles further, and will be done by July 31 to Longview, our connection with the Texas & Pacific, and 180 miles from Hearne. We have 14 locomotives, Rogers' make, in Texas, 8 passenger and mail cars, 200 platform and 100 box cars here, besides more *en route* from New York. Have a small shop in running order at Hearne.

"The cotton and corn crop of the South never looked better at this time of the year. The railroads of this State will earn more money this coming season than ever before.

"The Houston & Texas Central Railroad is nearly finished to Dallas.

"The Houston & Great Northern is about complete to Crockett, and will be at Palestine by November 1; then north of that to the State line this winter.

"General Dodge is starting his engineer corps out on the Texas & Pacific."

California & Oregon.

The graders on the California end of this road are at work above the American Ranch. It is believed that the road will be completed to Shasta Valley in a year.

Wellington, Grey & Bruce.

By an Order in Council the Ontario Government have decided to give a bonus of $2,000 a mile to that part of the Southern Extension Branch of the Wellington, Grey & Bruce line between Wingham and Kincardine, uncoupled with any condition that they shall give running powers to the London, Huron & Bruce Railway Company, or similar running powers to the Toronto, Grey & Bruce.

Baltimore & Potomac.

The new passenger and freight depot at the corner of Pennsylvania avenue and Cooke street, Baltimore, has been completed. This depot will be used until the completion of the tunnel. Between Baltimore and Washington, the road has been completed and ballasted, and trains were to begin running July 1. It is stated that the fare between the two cities will be 60 and 80 cents.

Suspension Bridge & Erie Junction.

This company, whose road from Buffalo to Niagara Falls and Suspension Bridge was built for and is leased and worked by the Erie Company, and affords it a connection with the Great Western Railway of Canada, failed to pay the interest on its bonds due July 1. The Erie Company was to pay as rental 7 per cent. on the stock and bonds, amounting to $1,500,000; and this company, it is said, has permitted the default in order to protect itself for advances made in the construction. It is hardly probable that the Erie will give up the lease, although it seems exhorbitant, for the line gives it its only connection with the Falls, thus securing a large pleasure travel, and is now its only connection with the Great Western, though when the Air-Line is completed it will have another and a shorter one.

Mansfield, Coldwater & Lake Michigan.

A telegram from Mansfield, O., contradicts the report that this road would not be ironed at present, and says that track-laying will begin between Mansfield and Toledo, within ten days.

Pittsburgh, Fort Wayne & Chicago.

It is reported that this road is to be straightened by running a line, nearly direct, from near Orrville to Mansfield, O., saving over ten miles in distance.

Long Island Central.

Contractors on this road have commenced work on the depot buildings at Hinsdale, near Queens, and at Creed Station, one mile south of Queens, and also on the round-house at the junction with the North Side road, near Flushing.

Elizabethtown & Paducah.

A telegram from Louisville, dated June 29, says: "An exciting contest took place to-day, on the election of Directors of the Elizabethtown & Paducah Railroad. Louisville heretofore had a majority in the board, but to-day the counties along the line combined and outvoted the city, electing a majority of members. This is regarded as looking to the extension of the road from Elizabethtown to Lexington."

Louisville, New Albany & Chicago.

A fire broke out in the repair shops of this road, at Lafayette, Ind., on the afternoon of June 20, and resulted in the destruction of the machine shop. There were four locomotives in the shop, three in running order and one stripped for repairs; all were very seriously damaged. The building was all frame, and all of a very temporary character. Loss, probably $50,000; partially covered by insurance.

Galena & Muscoda.

The Dubuque *Telegraph*, of recent date, says that contracts have been let for building and equipping this narrow gauge road. Mr. Hunkins, of Galena, is the principal contractor, and work is to begin immediately.

St. Louis & St. Charles.

Colonel Schofield of Quincy, Ill., has submitted a proposition for the construction of this road. It is proposed to finish the road this year. Its length is 20 miles. It is proposed to connect at St. Charles (where also the St. Louis, Kansas City & Northern crosses the Missouri) with the St. Louis & Keokuk and other roads which may desire an entrance in St. Louis from the country north of the Missouri.

St. Louis, Vandalia, Terre Haute & Indianapolis.

The General Freight Agent's office of this road, commonly known as the "Vandalia line," was removed from Indianapolis to St. Louis, July 1.

Railroad Consolidation.

It is reported that there is to be a consolidation of the general freight and passenger management of the line of road from Bristol, Va., to New Orleans, comprising the East Tennessee, Virginia & Georgia road; the Memphis & Charleston to Grand Junction, the Mississippi Central from Grand Junction to Canton, and the New Orleans, Jackson & Great Northern, from Canton to New Orleans. The new arrangement is to go into effect early in July, under the control of the Southern Railway Security Company.

Atchison, Topeka & Santa Fe.

The road was opened for traffic to Raymond, July 2. Cattle yards have been built there, and it is expected that it will become a prominent shipping point for Texas stock.

Southern Pacific of California.

The Salinas City *Index* says that work has commenced on the extension from Pajaro to the Salinas Valley. It is expected that the road will be completed to Salinas City in time to move this year's crop.

Marin County & Coast.

It is now said that this road will not be built as originally surveyed and located, but that the company will build a road from Sancelito to San Rafael, thence up the valley of San Antonio Creek, near the Sonoma County line, to Tomales. The company proposes to release Marin County from its subscription of $160,000, but ask that they be voted a new subscription of $330,000, which would be about $5,000 per mile for the road within the county.

Connecticut Western.

The Springfield *Republican* says:

"The long dormant Connecticut Western Railroad question has lately been stirred up a little by "the party of the other part," our friends on the other side of the Connecticut line. They say that they want the road extended from Tariffville to Springfield, but don't want Springfield to insist on the proposed guaranty of 6 per cent. for her investment for the next 20 years. The argument is that Hartford has put in her money the same as any private stockholder, being satisfied at present with the benefits conferred by the road, and with the possibility of dividends some time in the future; and that Springfield ought to be willing to welcome the road on the same terms. So it is proposed to have the extension from Tariffville hither built virtually by the Connecticut Western Company, to which, by some method of "fixing up," the $500,000 subscription of Springfield is to be transferred, although by what means the city can subscribe money for building a road outside of the State, is not clear. Vermont Central Railroad influences, which are becoming so potent in many parts of New England, will no doubt be felt in hastening the completion of this line. With an unbroken track from the Canada line to this city—a result assured by the building of the Athol & Enfield Railroad Extension—the Vermont Central will not be content without a more direct outlet than its present one to New York. This the Connecticut Western will give in several ways, and when Governor Smith makes up his mind to bridge the little chasm between this city and Tariffville, the present difficulties in the way will vanish, and the southwestern connections we have talked about so long will become a realized fact."

The La Crosse Bridge.

Mr. J. T. Dodge, the Chief Engineer, advertises for proposals for supplying materials, and constructing this bridge, which is to connect what is now known as the "River Division" of the Milwaukee & St. Paul Railway with the La Crosse Division. The approximate estimates are as follows: 1 drawbridge and turn-table (iron), 360 feet; 1 fixed span (iron), 250 feet; 1 drawbridge (wood), with turn-table of iron, 200 feet; 3 spans, wood or combination, 150 feet each; 4 spans, wood or combination, 180 feet each; 2 spans, wood or combination, 150 feet each; 4,500 yards first-class bridge masonry; 115,000 lineal feet piles; 200,000 feet b. m. timber in foundations; 1,100,000 feet b. m. timber, except in foundations; 18,000 cubic yards rip rap. The bids may be made for any part of the work, or the whole, to be entirely completed by April next. Plans and further information may be obtained of Mr. Dodge, at Winona, Minn. The proposals will be received until July 17.

Albany & Susquehanna.

The Delaware & Hudson Canal Company, lessees, have laid down a third rail on the Sharon Springs & Cherry Valley Branch, which enables them to carry passengers through from New York without change of cars.

Barclay Railroad.

This road, which has been leased by the Towanda Coal Company since 1870, at an annual rent of $30,000, is 16 miles long. The company owns 6 engines and 447 coal cars and carried 312,235 tons of bituminous coal in 1871. The cost of operating the road was $107,258, besides the rental, and the receipts from passengers and freight were $43,371. From Towanda to Waverley they pass over the Pennsylvania & New York Division of the Lehigh Valley Road, paying trackage for the same. The Barclay Coal Company has a capital stock of $1,000,000, and a funded debt of $93,000. There was paid during 1871 a dividend of $3 per share on the 20,000 shares of a par value of $50. The mines, as well as the railroad, are leased by the Towanda Coal Company.

Allegheny Valley.

The Bennett's Branch Extension is rapidly approaching completion. Ties are now being laid from Driftwood on the Philadelphia & Erie road westward, and about 19 miles are completely graded.

Bedford & Bridgeport.

Another month will finish the grading on the extension of this road to the Maryland line, and the road will be opened to Cumberland as soon after that as the rails can be laid down.

Lehigh Coal & Navigation Company.

This company has begun the erection of their offices, shops and dwelling-houses at Lansford, in the Panther Creek Valley, at the south approach of the Nesquehoning Tunnel. Besides the offices and ten or a dozen dwelling-houses for officers of the company, a planing-mill, a large foundry and spacious machine shop are to be put up, in which the company expect, hereafter, to do all their own work.

The Philadelphia offices of the company have been removed from Second street to the building on Third street and Willing's alley lately occupied by the Pennsylvania Railroad Company.

Southeastern Pennsylvania Railroads.

The Wilmington & Reading Railroad Company have nearly finished the grading of their line from Birdsboro to Reading, and contracts are advertised to be let for constructing the Berks County Railroad, which is to connect the Wilmington & Reading with the Lehigh Valley road. The Wilmington & Western, which runs from Wilmington, Del., to Landenburg, Chester County, Pa., was to open July 4. The Pennsylvania & Delaware, from Pomeroy, on the Pennsylvania road, 42 miles from Philadelphia southeast to Delaware City, Del., is being rapidly pushed forward. A corps of engineers is now surveying a line through Chester County for a proposed new line from Philadelphia to Baltimore. The survey runs from the Maryland State line as nearly as possible half way between the Pennsylvania and Philadelphia & Baltimore Central roads.

Proposed Narrow-Gauge Road.

It is stated that the Keystone Coal Company of Somerset County, Pa., propose to build a narrow-gauge road from the Company's mines in Elk Lick township to the nearest point on the Pittsburgh & Connellsville Railroad. The road will be about five and one-half miles long and will strike the Pittsburgh & Connellsville about three miles east of Meyer's Mills. It is to be commenced at once.

Eastern Railroad.

The new station of this road and the Maine Central, in Portland, will be built near the site of the present station of the Portsmouth, Saco & Portland Railroad, on the sea wall.

Texas Pacific.

The surveying corps on this road returned to Fort Worth June 5, and commenced the survey of the road toward the Pacific Coast. After reaching Weatherford, the party will have an escort of 100 United States troops.

Erie Railway.

The London directors, Messrs. W. W. Cryden, Edward H. Green and Gilson Homan, on announcing the retirement of the London (Bischoffsheim & Goldschmidt) committee, and their own election, announced that their information from New York indicated that the gross earnings were greatly in excess of the amounts stated by the late management; that the road and equipment were in excellent order; that the rolling stock in use belonging to other corporations was much less than had been reported, that contracts improvidently or fraudulently made were being investigated and that indemnity would be claimed for any loss so accruing; that the pressing floating debts had been met by a temporary loan, and that, beginning with the fiscal year from July 1, 1872, the net revenue would doubtless enable the company to pay dividends on the share capital.

The law regulating the election of this company provide that not only must the shares be registered in the name of the person offering to vote on them at the election, or his agent, but he must be the owner of them also at the time of election—which is equivalent to limiting votes to shares which have been held continuously by one proprietor from the 18th of June till July 9.

There have been reports that the heavy English holders have so largely sold out since the closing of transfers that they no longer hold a majority, and that likely enough the election might result in favor of a party of American holders, who would reinstate Jay Gould. This is good for a sensation and might be true; but it is even harder to believe that Mr. Gould and his friends have held on to stock which they might have sold out at 70 or thereabouts than that the English holders would give up the control which they secured with so much trouble.

Matthias W. Baldwin and Early American Locomotives.

We continue this week the publication of a part of the very interesting historical sketch given in the introduction of the new catalogue of the Baldwin Locomotive Works.

Early in 1835, the new shop on Broad street was completed and occupied. Mr. Baldwin's attention was thenceforward given to the locomotive building exclusively, except that a stationary engine was occasionally constructed.

In May, 1835, his eleventh locomotive, the "Black Hawk," was delivered to the Philadelphia & Trenton Railroad Company. This was the first outside-connected engine of his build. It was also the first engine on which the Miller device of attaching part of the weight of the tender to the engine was employed. On the eighteenth engine, the "Brandywine," built for the Philadelphia & Columbia Railroad Company, brass tires were used on the driving-wheels, for the purpose of obtaining more adhesion; but they wore out rapidly and were replaced with iron.

Fourteen engines were constructed in 1835; forty in 1836; forty in 1837; twenty-three in 1838; twenty-six in 1839; and nine in 1840. During all these years the general design continued the same; but, in compliance with the demand for more power, three sizes were furnished, as follows:

First-class.	Cylinders,	12½ × 16;	weight, loaded,	26,000 pounds.
Second-class.	"	12 × 16;	" "	23,000 "
Third class.	"	10½ × 16;	" "	20,000 "

The first-class engine he fully believed, in 1838, was as heavy as would be called for, and he declared that it was as large as he intended to make. Most of the engines were built with the half-crank, but occasionally an outside-connected machine was turned out. These latter, however, failed to give as complete satisfaction as the half-crank machine. The drivers were generally four and a half feet in diameter.

A patent was issued to Mr. Baldwin, August 17, 1836, for his device of cylindrical pedestals. In this method of construction the pedestal was of cast-iron, and was bored in a lathe so as to form two concave jaws. The boxes were also turned in a lathe so that their vertical ends were cylindrical, and they were thus fitted in the pedestals. This method of fitting up pedestals and boxes was cheap and effective, and was used for some years for the driving and tender wheels.

As showing the estimation in which these early engines were held, it may not be out of place to refer to the opinions of some of the railroad managers of that period.

Mr. L. A. Sykes, engineer of the New Jersey Transportation Company, under date of June 12, 1838, wrote that he could draw with his engines twenty four-wheeled cars with 26 passengers each at a speed of 20 to 25 miles per hour, over grades of 26 feet per mile. "As to simplicity of construction," he adds, "small liability to get out of order, economy of repairs, and ease to the road, I fully believe Mr. Baldwin's engines stand unrivalled. I consider the simplicity of the engine, the arrangement of the working parts and the distribution of the weight far superior to any engine I have ever seen, either of American or English manufacture, and I have not the least hesitation in saying that Mr. Baldwin's engine will do the same amount of work with much less repairs, either to the engine or the track, than any other engine in use."

L. G. Cannon, President of the Rensselaer & Saratoga Railroad Company, writes, "Your engines will, in performance and cost of repairs, bear comparison with any other engine made in this or any other country."

Some of Mr. Baldwin's engines on the State Road in 1837 cost for repairs only from one and two-tenths to one and six-tenths cents per mile. It is noted that the engine "West Chester," on the same road, weighing 20,735 pounds (10,475 on drivers), drew 51 cars (four-wheeled), weighing 289 net tons, over the road, some of the track being of wood covered with strap-rail.

* * * * * * *

The changes and improvements in details made during these years [1838, 1839 and 1840] may be summed up as follows:

The subject of burning coal had engaged much attention. In October, 1836, Mr. Baldwin secured a patent for a grate or fireplace which could be detached from the engine at pleasure, and a new one with a fresh coal fire substituted. The intention was to have the grate with freshly ignited coal all ready for the engine on its arrival at a station, and placed between the rails over suitable levers, by which it could be attached quickly to the fire-box. It is needless to say that this was never practiced. In January, 1838, however, Mr. Baldwin was experimenting with the consumption of coal on the Germantown road, and in July of the same year the records show that he was making a locomotive to burn coal, part of the arrangement being to blow the fire with a fan.

Up to 1838, Mr. Baldwin had made both driving and truck wheels with wrought tires, but during that year chilled wheels for engine and tender trucks were adopted. His tires were furnished by Messrs. S. Vail & Son, Morristown, N.J., who made the only tires then obtainable in America. They were very thin, being only one inch to one and a half inches thick; and Mr. Baldwin, in importing some tires from England at that time, insisted on their being made double the ordinary thickness. The manufacturers at first objected and ridiculed the idea, the practice being to use two tires when extra thickness was wanted, but finally they consented to meet his requirements.

All his engines thus far had the single eccentric for each valve; but at about this period double eccentrics were adopted, each terminating in a straight hook, and reversed by hand-levers.

At this early period, Mr. Baldwin had begun to feel the necessity of making all like parts of locomotives of the same class in such manner as to be absolutely interchangeable. Steps were taken in this direction, but it was not until many years afterward that the system of standard gauges was perfected, which has since grown to be a distinguishing feature in the establishment.

In March, 1839, Mr. Baldwin's records show that he was building a number of outside-connected engines, and had succeeded in making them strong and durable. He was also making a new chilled wheel, and one which he thought would not break.

On the one hundred and thirty-sixth locomotive, completed October 18, 1839, for the Philadelphia, Germantown & Norristown Railroad, the old pattern of wooden frame was abandoned, and no outside frame whatever was employed—the machinery, as well as the truck and the pedestals of the driving-axles, being attached directly to the naked boiler. The wooden frame thenceforward disappeared gradually, and an iron frame took its place. Another innovation was the adoption of eight-wheeled tenders, the first of which was built at about this period.

April 8, 1839, Mr. Baldwin associated with himself Messrs. Vail and Hufty, and the business was conducted under the firm name of Baldwin, Vail & Hufty until 1841, when Mr. Hufty withdrew, and Baldwin & Vail continued the copartnership until 1842.

The time had now arrived when the increase of business on railroads demanded more powerful locomotives. It had for some years been felt that for freight traffic the engine with one pair of drivers was insufficient. Mr. Baldwin's engine had the single pair of drivers placed back of the fire-box; that made by Mr. Norris, one pair in front of the fire-box. An engine with two pair of drivers, one pair in front and one pair behind the fire-box, was the next logical step, and Mr. Henry R. Campbell, of Philadelphia, was the first to carry this design into execution. Mr. Campbell, as has been noted, was the Chief Engineer of the Germantown Railroad when the "Ironsides" was placed on that line, and had since given much attention to the subject of locomotive construction. February 5, 1836, Mr. Campbell secured a patent for an eight-wheeled engine with four drivers connected and a four-wheeled truck in front; and subsequently contracted with James Brooks, of Philadelphia, to build for him such a machine. The work was begun March 16, 1836, and the engine was completed May 8, 1837. This was the first eight-wheeled engine of this type, and from it the standard American locomotive of to-day takes its origin. The engine lacked, however, one essential feature; there were no equalizing beams between the drivers, and nothing but the ordinary steel springs over each journal of the driving-axles to equalize the weight upon them. It remained for Messrs. Eastwick & Harrison to supply this deficiency; and in 1837 that firm constructed at their shop in Philadelphia a locomotive on this plan, but with the driving-axles running in a separate square frame, connected to the main frame above it by a single central bearing on each side. This engine had cylinders 12 by 18, four coupled driving-wheels, 44 inches in diameter, carrying eight of the twelve tons constituting the total weight. Subsequently, Mr. Joseph Harrison, Jr., of the same firm, substituted "equalizing beams" on engines of this plan afterward constructed by them, substantially in the same manner as since generally employed.

In the *American Railroad Journal* of July 30, 1836, a woodcut, showing Mr. Campbell's engine, together with an elaborate calculation of the effective power of an engine on this plan, by William J. Lewis, Esq., Civil Engineer, was published, with a table showing its performance upon grades ranging from a dead level to a rise of 100 feet per mile. Mr. Campbell stated that his experience at that time (1835-6) convinced him that grades of 100 feet rise per mile would, if roads were judiciously located, carry railroads over any of the mountain passes in America, without the use of planes with stationary steam power, or, as a general rule, of costly tunnels—an opinion very extensively verified by the experience of the country since that date.

A step had thus been taken toward a plan of locomotive having more adhesive power. Mr. Baldwin, however, was slow to adopt the new design. He naturally regarded innovations with distrust. He had done much to perfect the old pattern of engine, and had built over a hundred of them, which were in successful operation on various railroads. Many of the details were the subjects of his several patents, and had been greatly simplified in his practice. In fact, simplicity in all the working parts had been so largely his aim that it was natural that he should distrust any plan involving additional machinery, and he regarded the new design as only an experiment at best. In November, 1838, he wrote to a correspondent that he did not think there was any advantage in the eight-wheeled engine. There being three points in contact, it could not turn a curve, he argued, without slipping one or the other pair of wheels sideways. Another objection was in the multiplicity of machinery and the difficulty in maintaining four driving-wheels all of exactly the same size. Some means, however, of getting more adhesion must be had, and the result of his reflections upon this subject was the project of a "geared engine." In August, 1839, he took steps to secure a patent for such a machine, and December 31, 1840, letters patent were granted him for the device. In this engine, an independent shaft or axle was placed between the two axles of the truck, and connected by cranks and coupling-rods with cranks on the outside of the driving-wheels. This shaft had a central cog-wheel engaging on each side with intermediate cog-wheels, which in turn geared into cog-wheels on each truck-axle. The intermediate cog-wheels had wide teeth, so that the truck could pivot while the main shaft remained parallel with the driving-axle. The diameters of the cog-wheels were, of course, in such proportion to the driving and truck wheels, that the latter should revolve as much oftener than the drivers as their smaller size might require. Of the success of this machine for freight service, Mr. Baldwin was very sanguine. One was put in hand at once, completed in August, 1841, and eventually sold to the Sugarloaf Coal Company. It was an outside-connected engine, weighing 30,000 pounds, of which 11,775 pounds were on the drivers, and 18,335 on the truck. The driving-wheels were 44 and the truck-wheels 33 inches in diameter. The cylinders were 13 inches in diameter by 16 inches stroke. On a trial of the engine upon the Philadelphia & Reading Railroad, it hauled 590 tons from Reading to Philadelphia—a distance of 54 miles—in 5 hours and 22 minutes. The Superintendent of the road, in writing of the trial, remarked that this train was unprecedented in length and weight both in America and Europe. The performance was noticed in favorable terms by the Philadelphia newspapers, and was made the subject of a report by the Committee on Science and Arts of the Franklin Institute, who strongly recommended this plan of engine for freight service. The success of the trial led Mr. Baldwin at first to believe that the geared engine would be generally adopted for freight traffic; but in this he was disappointed. No further demand was made for such machines, and no more of them were built.

In 1840, Mr. Baldwin received an order, through August Belmont, Esq., of New York, for a locomotive for Austria, and had nearly completed one which was calculated to do the work required, when he learned that only 60 pounds pressure of steam was admissible, whereas his engine was designed to use steam at 100 pounds and over. He accordingly constructed another, meeting this requirement, and shipped it in the following year. This engine, it may be noted, had a kind of link-motion, agreeably to the specification received, and was the first of his make upon which the link was introduced.

Mr. Baldwin's patent of December 31, 1840, already referred to as covering his geared engine, embraced several other devices, as follows:

1. A method of operating a fan, or blowing-wheel, for the purpose of blowing the fire. The fan was to be placed under the footboard, and driven by the friction of a grooved pulley in contact with the flange of the driving-wheel.

2. The substitution of a metallic stuffing, consisting of wire, for the hemp, wool or other material which had been employed in stuffing boxes.

3. The placing of the springs of the engine truck so as to obviate the evil of the locking of the wheels when the truck-frame vibrates from the center-pin vertically. Spiral as well as semi-elliptic springs, placed at each end of the truck-frame, were specified. The spiral spring is described as received in two cups—one above and one below. The cups were connected together at the centers by a pin upon one and a socket in the other, so that the cups could approach toward or recede from each other and still preserve their parallelism.

4. An improvement in the manner of constructing the iron frames of locomotives, by making the pedestals in one piece with, and constituting part of, the frames.

5. The employment of spiral springs in connection with cylindrical pedestals and boxes. A single spiral was at first used, but, not proving sufficiently strong, a combination or nest of spirals curving alternately in opposite directions was afterward employed. Each spiral had its bearing in a spiral recess in the pedestal.

In the specification of this patent a change in the method of making cylindrical pedestals and boxes is noted. Instead of boring and turning them in a lathe, they were cast to the required shape in chills. This method of construction was used for a time, but eventually a return was made to the original plan, as giving a more accurate job.

In 1842 Mr. Baldwin constructed, under an arrangement with Mr. Ross Winans, three locomotives for the Western Railroad of Massachusetts, on a plan which had been designed by that gentleman for freight traffic. These machines had upright boilers, and horizontal cylinders which worked cranks on a shaft bearing cog-wheels engaging with other cog-wheels on an intermediate shaft. This latter shaft had cranks coupled to four driving-wheels on each side. These engines were constructed to burn anthracite coal. Their peculiarly uncouth appearance earned for them the name of "crabs," and they were but short-lived in service.

But to return to the progress of Mr. Baldwin's locomotive practice. The geared engine had not proved a success. It was unsatisfactory, as well to its designer as to the railroad community. The problem of utilizing more or all of the weight of the engine remained, in Mr. Baldwin's view, yet to be solved. The plan of coupling four or six wheels had long before been adopted in England, but on the short curves prevalent on American railroads he felt that something more was necessary. The wheels must not only be coupled, but at the same time must be free to adapt themselves to a curve. These two conditions were apparently incompatible, and to reconcile these inconsistencies was the task which Mr. Baldwin set himself to accomplish. He undertook it, too, at a time when his business had fallen off greatly, and he was involved in the most serious financial embarrassments. The problem was constantly before him, and at length, during a sleepless night, its solution flashed across his mind. The plan so long sought for, and which, subsequently, more than any other of his improvements and inventions, contributed to the foundation of his fortune, was his well-known six-wheels-connected locomotive with the four front drivers combined in a flexible truck. For this machine Mr. Baldwin secured a patent, August 25, 1842. Its principal characteristic features are now matters of history, but they deserve here a brief mention. The engine was on six wheels, all connected as drivers. The rear wheels were placed rigidly in the frames, usually behind the fire-box, with inside bearings. The cylinders were inclined, and with outside connections. The four remaining wheels had inside journals running in boxes held by two wide

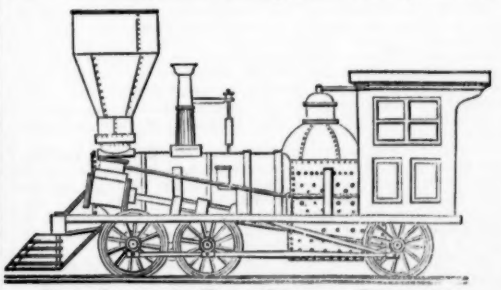


Fig. 6.—Baldwin Six-Wheels-Connected Engine, 1842.

and deep wrought-iron beams, one on each side. These beams were unconnected, and entirely independent of each other. The pedestals formed in them were bored out cylindrically, and into them cylindrical boxes, as patented by him in 1835, were fitted. The engine-frame on each side was directly over the beam, and a spherical pin, running down from the frame, bore in a socket in the beam midway between the two

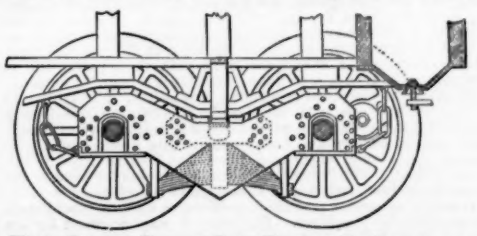
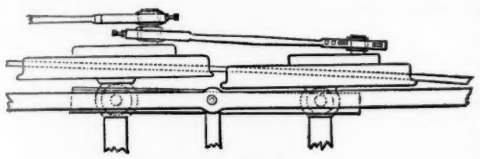


Fig. 7.—Baldwin Flexible-Beam Truck, 1842.—Elevation.

axles. It will thus be seen that each side-beam, independently, could turn horizontally or vertically under the spherical pin,

and the cylindrical boxes could also turn in the pedestals. Hence, in passing a curve, the middle pair of drivers could



HALF PLAN.

move laterally in one direction—say to the right—while the front pair could move in the opposite direction, or to the left; the two axles all the while remaining parallel to each other and to the rear driving-axle. The operation of these beams was, therefore, like that of the parallel-ruler. On a straight line the two beams and the two axles formed a rectangle; on curves, a parallelogram, the angles varying with the degree of curvature. The coupling-rods were made with cylindrical brasses, thus forming ball and socket-joints, to enable them to accommodate themselves to the lateral movements of the wheels. Colburn, in his "Locomotive Engineering," remarks of this arrangement of rods as follows:

"Geometrically, no doubt, this combination of wheels could only work properly around curves by a lengthening and shortening of the rods which served to couple the principal pair of driving-wheels with the hind truck-wheels. But if the coupling-rods from the principal pair of driving-wheels be five feet long, and if the beams of the truck-frame be four feet long (the radius of curve described by the axle-boxes around the spherical side bearings being two feet), then the total corresponding lengthening of the coupling-rods, in order to allow the hind truck-wheels to move one inch to one side, and the front wheels of the truck one inch to the other side of their normal position on a straight line, would be $\sqrt{60^2+1^2}-60+24-\sqrt{24^2-1^2}=0.0275$ inch, or less than one thirty-second of an inch. And if only one pair of driving-wheels were thus coupled with a four-wheeled truck, the total wheel-base being nine feet, the motion permitted by this slight elongation of the coupling-rods (an elongation provided for by a trifling slackness in the brasses) would enable three pairs of wheels to stand without binding in a curve of only one hundred feet radius."

The first engine of the new plan was finished early in December, 1842, being one of fourteen engines constructed in that year, and was sent to the Georgia Railroad, on the order of Mr. J. Edgar Thomson, then Chief Engineer and Superintendent of that line. It weighed twelve tons and drew, besides its own weight, 250 tons up a grade of 36 feet to the mile.

Other orders soon followed. The new machine was received generally with great favor. The loads hauled by it exceeded anything so far known in American railroad practice, and sagacious managers hailed it as a means of largely reducing operating expenses. On the Central Railroad of Georgia, one of these twelve-ton engines drew 19 eight-wheeled cars, with 750 bales of cotton, each bale weighing 450 pounds, over maximum grades of 30 feet per mile, and the manager of the road declared that it could readily take 1,000 bales. On the Philadelphia & Reading Railroad a similar engine of 18 tons weight drew 150 loaded cars (total weight of cars and lading, 1,130 tons) from Schuylkill Haven to Philadelphia, at a speed of seven miles per hour. The regular load was 100 loaded cars, which were hauled at a speed of from twelve to fifteen miles per hour on a level.

But the flexible-beam truck also enabled Mr. Baldwin to meet the demand for an engine with four drivers connected. Other builders were making engines with four drivers and a four-wheeled truck, of the present American standard type. To compete with this design, Mr. Baldwin modified his six-wheels-connected engine by connecting only two out of the three pairs of wheels as drivers, making the forward wheels of smaller diameter as leading wheels, but combining them with the front drivers in a flexible-beam truck. The first engine on this plan was sent to the Erie & Kalamazoo Railroad in October, 1843, and gave great satisfaction. The Superintendent of the road was enthusiastic in its praise, and wrote to Mr. Baldwin that he doubted "if anything could be got up which would answer the business of the road so well." One was also sent to the Utica & Schenectady Railroad a few weeks later, of which the Superintendent remarked that "it worked beautifully, and there were not wagons enough to give it a full load." In this plan the leading wheels were u sually made 36 and the drivers 54 inches in diameter.

This machine of course came in competition with the eight-wheeled engine having four drivers, and Mr. Baldwin claimed for his plan a decided superiority. In each case about two-thirds of the total weight was carried on the four drivers, and Mr. Baldwin maintained that his engine, having only six instead of eight wheels, was simpler and more effective.

With the introduction of the new machine, business began at once to revive, and the tide of prosperity turned once more in Mr. Baldwin's favor. Twelve engines were constructed in 1843, all but four of them of the new pattern; 22 engines in 1844, all of the new pattern; and 27 in 1845. Three of this number were of the old type, with one pair of drivers, but from that time forward the old pattern with the single pair of drivers disappeared from the practice of the establishment, save occasionally for exceptional purposes.

In 1842, the partnership with Mr. Vail was dissolved, and Mr. Asa Whitney, who had been Superintendent of the Mohawk & Hudson Railroad, became a partner with Mr. Baldwin, and the firm continued as Baldwin & Whitney until 1846, when the latter withdrew to engage in the manufacture of car-wheels, in which business he is still concerned as senior member of the firm of A. Whitney & Sons, Philadelphia.

Mr. Whitney brought to the firm a railroad experience and thorough business talent. He introduced a system in many details of the management of the business, which Mr. Baldwin, whose mind was devoted more exclusively to mechanical subjects, had failed to establish or wholly ignored. The method at present in use in the establishment, of giving to each class of locomotives a distinctive designation, composed of a number and a letter, originated very shortly after Mr. Whitney's connection with the business. For the purpose of representing the different designs, sheets with engravings of locomotives were employed. The sheet showing the engine with one pair of drivers was marked B; that with two pairs, C; that with three, D; and that with four, E. Taking its rise from this circumstance, it became customary to designate as B engines those with one pair of drivers; as C engines, those with two pairs; as D engines, those with three pairs; and as E engines, those with four pairs. Shortly afterward, a number, indicating the weight in gross tons, was added. Thus, the 12 D engine was one with three pairs of drivers, and weighing twelve tons; the 12 C, an engine of same weight, but with only four wheels connected. Substantially this system of designating the several sizes and plans has been retained to the present time. The figures, however, are no longer used to express the weight, but merely to designate the class.

It will be observed that the classification as thus established began with the B engines. The letter A was reserved for an engine intended to run at very high speed, and so designed that the driving-wheels should make two revolutions for each reciprocation of the pistons. This was to be accomplished by means of gearing. The general plan of the engine was determined in Mr. Baldwin's mind, but was never carried into execution. The adoption of the plan of six-wheels-connected engines opened the way at once to increasing their size. The weight being almost evenly distributed on six points, heavier machines were admissible, the weight on any one pair of drivers being little, if any, greater than had been the practice with the old plan of engine having a single pair of drivers. Hence engines of eighteen and twenty tons weight were shortly introduced, and in 1844 three of twenty tons weight, with cylinders 16½ inches diameter by 18 inches stroke, were constructed for the Western Railroad of Massachusetts, and six, of eighteen tons weight, with cylinders 15 by 18, and drivers 46 inches in diameter, were built for the Philadelphia & Reading Railroad. It should be noted that three of these latter engines had iron flues. This was the first instance in which Mr. Baldwin had employed tubes of this material. The advantage found to result from the use of iron tubes, apart from their less cost, was that the tubes and boiler-shell, being of the same material, expanded and contracted alike, while in the case of copper tubes the expansion of the metal by heat varied from that of the boiler-shell, and as a consequence there was greater liability to leakage at the joints with the tube-sheets. The opinion prevailed largely at that time that some advantage resulted in the evaporation of water, owing to the superiority of copper as a conductor of heat. To determine this question, an experiment was tried with two of the six engines referred to above, one of which, the "Ontario," had copper flues, and another, the "New England," iron flues. In other respects they were precisely alike. The two engines were run from Richmond to Mount Carbon, August 27, 1844, each drawing a train of 101 empty cars, and, returning, from Mount Carbon to Richmond, on the following day, each with 100 loaded cars. The quantity of water evaporated and wood consumed was noted, with the result shown in the following table:

	Up Trip, Aug. 27, 1844.	
	"Ontario." (Copper Flues.)	"New England." (Iron Flues.)
Time, running	9h. 7m.	7h. 41m.
" standing at stations	4h. 2m.	3h. 7m.
Cords of wood burned	6 68	5.50
Cubic feet of water evaporated	925.75	757.46
Ratio, cubic feet of water to a cord of wood	138.57	137.68

	Down Trip, Aug. 28, 1844.	
	"Ontario." (Copper Flues.)	"New England." (Iron Flues.)
Time, running	10h. 44m.	8h. 19m.
" standing at stations	2h. 12m.	3h. 8m.
Cords of wood burned	6 94	6
Cubic feet of water evaporated	837.46	656.39
Ratio, cubic feet of water to a cord of wood	120.67	109.39

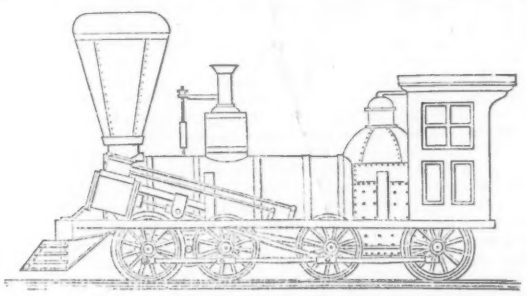
The conditions of the experiments not being absolutely the same in each case, the results could not of course be accepted as entirely accurate. They seemed to show, however, no considerable difference in the evaporative efficacy of copper and iron tubes.

The period under consideration was marked also by the introduction of the French & Baird stack, which proved at once to be one of the most successful spark-arresters thus far employed, and which was for years used almost exclusively wherever, as on the cotton-carrying railroads of the South, a thoroughly effective spark-arrester was required. This stack was introduced by Mr. Baird, then a foreman in the works, who purchased the patent-right of what had been known as the Grimes stack, and combined with it some of the features of the stack made by Mr. Richard French, then Master Mechanic of the Germantown Railroad, together with certain improvements of his own. The cone over the straight inside pipe was made with volute flanges on its under side, which gave a rotary motion to the sparks. Around the cone was a casing about six inches smaller in diameter than the outside stack. Apertures were cut in the sides of this casing, through which the sparks in their rotary motion were discharged, and thus fell to the bottom of the space between the straight inside pipe and the outside stack. The opening in the top of the stack was fitted with a series of V-shaped iron circles perforated with numerous holes, thus presenting an enlarged area, through which the smoke escaped. The patent-right for this stack was subsequently sold to Messrs. Radley & Hunter, and its essential principle is still used in the Radley & Hunter stack as at present made.

In 1845, Mr. Baldwin built three locomotives for the Royal Railroad Committee of Wurtemberg. They were of 15 tons weight, on six wheels, four of them being 60 inches in diameter and coupled. The front drivers were combined by the flexible beams into a truck with the smaller leading wheels. The cylinders were inclined and outside, and the connecting-rods took hold of a half-crank axle back of the fire-box. It was specified that these engines should have the link-motion which had shortly before been introduced in England by the Stephensons. Mr. Baldwin accordingly applied a link of a peculiar character to suit his own ideas of the device. The link was made solid, and of a truncated V-section, and the block was grooved so as to fit and slide on the outside of the link.

During the year 1845 another important feature in locomotive construction—the cut-off valve—was added to Mr. Baldwin's practice. Up to that time the valve-motion had been the two eccentrics, with the single flat hook for cylinder. Since 1841 Mr. Baldwin had contemplated the addition of some device allowing the steam to be used expansively, and he now added the "half-stroke cut-off." In this device the steam-chest was separated by a horizontal plate into an upper and a lower compartment. In the upper compartment, a valve, worked by a separate eccentric, and having a single opening, admitted steam through a port in this plate to the lower steam-chamber. The valve-rod of the upper valve terminated in a notch or hook, which engaged with the upper arm of its rock-shaft. When thus working it acted as a cut-off at a fixed part of the stroke, determined by the setting of the eccentric. This was usually at half the stroke. When it was desired to dispense with the cut-off and work steam for the full stroke, the hook of the valve-rod was lifted from the pin on the upper arm of the rock-shaft by a lever worked from the footboard, and the valve-rod was held in a notched rest fastened to the side of the boiler. This left the opening through the upper valve and the port in the partition plate open for the free passage of steam throughout the whole stroke. The first application of the half-stroke cut-off was made on the engine "Champlain" (20 D), built for the Philadelphia & Reading Railroad Company, in 1845. It at once became the practice to apply the cut-off on all passenger engines, while the six and eight-wheels-connected freight engines were, with a few exceptions, built for a time longer with the single valve admitting steam for the full stroke.

After building, during the years 1843, 1844, 1845, ten four-wheels-connected engines on the plan above described, viz., six wheels in all, the leading wheels and the front drivers being combined into a truck by the flexible beams, Mr. Baldwin finally adopted the present design of four drivers and a four-wheeled truck. Some of his customers who were favorable to the latter plan had ordered such machines of other builders, and Colonel Gadsden, President of the South Carolina Railroad Company, called on him in 1845 to build for that line some passenger engines of this pattern. He accordingly bought the patent-right for this plan of engine of Mr. H. R. Campbell, and for the equalizing beams used between the drivers, of Messrs. Eastwick & Harrison, and delivered to the South Carolina Railroad Company, in December, 1845, his first eight-wheeled engine with four drivers and a four-wheeled truck. This machine had cylinders 13¾ by 18, and drivers 60 inches in diameter, with the



springs between them arranged as equalizers. Its weight was 15 tons. It had the half-crank axle, the cylinders being inside the frame but outside the smoke-box. The inside-connected engine, counterweighting being as yet unknown, was admitted to be steadier in running, and hence more suitable for passenger service. With the completion of the first eight-wheeled "C" engine, Mr. Baldwin's feelings underwent a revulsion in favor of this plan, and his partiality for it became as great as had been his antipathy before. Commenting on the machine, he recorded himself as "more pleased with its appearance and action than any engine he had turned out." In addition to the three engines of this description for the South Carolina Railroad Company, a duplicate was sent to the Camden & Amboy Railroad Company, and a similar but lighter one to the Wilmington & Baltimore Railroad Company, shortly afterward. The engine for the Camden & Amboy Railroad Company, and perhaps the others, had the half-stroke cut-off.

From that time forward, all of his four-wheels-connected machines were built on this plan, and the six-wheeled "C" engine was abandoned, except in the case of one built for the Philadelphia, Germantown & Norristown Railroad Company in 1846, and this was afterwards rebuilt into a six-wheels-connected machine. Three methods of carrying out the general design were, however, subsequently followed. At first the half-crank was used; then horizontal cylinders inclosed in the chimney-seat and working a full-crank-axle, which form of construction had been practiced at the Lowell Works; and eventually, outside cylinders with outside connections.

Meanwhile the flexible truck machine maintained its popularity for heavy freight service. All the engines thus far built on this plan had been six-wheeled, some with the rear driving-axle back of the fire-box, and others with it in front. The next step, following logically after the adoption of the eight-wheeled "C" engine, was to increase the size of the freight machine, and distribute the weight on eight wheels all connected, the two rear pairs being rigid in the frame, and the two front pairs combined into the flexible-beam truck. This was first done in 1846, when 17 engines on this plan were constructed on one order for the Philadelphia & Reading Railroad Company. Fifteen of these were of 20 tons weight, with cylinders 15½ by 20, and wheels 46 inches in diameter; and two of 25 tons weight, with cylinders 17½ by 18, and drivers 42 inches in diameter. These engines were the first ones on which Mr. Baldwin placed sand-boxes, and they were also the first built by him with roofs. On all previous engines the footboard had only been inclosed by a railing. On these engines for the Reading Railroad, four iron posts were carried up, and a wooden roof supported by them. The engine-men added curtains at the sides and front, and Mr. Baldwin on subsequent engines added sides, with sash and glass. The cab proper, however, was of New England origin, where the severity of the climate demanded it, and where it had been used previous to this period.

Forty-two engines were completed in 1846 and 39 in 1847. The only novelty to be noted among them was the engine "M. G. Bright," built for operating the inclined plane on the

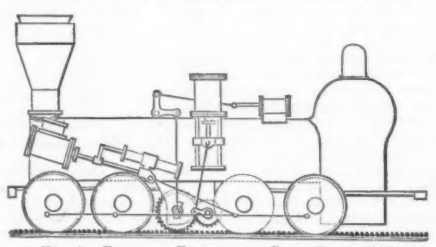


FIG. 9.—BALDWIN ENGINE FOR RACK RAIL, 1847.

Madison & Indianapolis Railroad. The rise of this incline was one in 17 from the bank of the Ohio River at Madison. The engine had eight wheels, 42 inches in diameter, connected, and worked in the usual manner by outside inclined cylinders, 15½ inches diameter by 20 inches stroke. A second pair of cylinders, 17 inches in diameter with 18 inches stroke of piston, was placed vertically over the boiler, midway between the furnace and smoke-arch. The connecting-rods worked by these cylinders connected with cranks on a shaft under the boiler. This shaft carried a single cog-wheel at its center, and this cog-wheel engaged with another of about twice its diameter on a second shaft adjacent to it and in the same plane. The cog-wheel on this latter shaft worked in a rack-rail placed in the center of the track. The shaft itself had its bearings in the lower ends of two vertical rods, one on each side of the boiler, and these rods were united over the boiler by a horizontal bar which was connected by means of a bent lever and connecting-rod to the piston worked by a small horizontal cylinder placed on top of the boiler. By means of this cylinder, the yoke carrying the shaft and cog-wheel could be depressed and held down so as to engage the cogs with the rack-rail, or raised out of the way when only the ordinary drivers were required. This device was designed by Mr. Andrew Cathcart, Master Mechanic of the Madison & Indianapolis Railroad. A similar machine, the "John Brough," for the same plane, was built by Mr. Baldwin in 1850. The incline was worked with a rack-rail and these engines until it was finally abandoned and a line with easy gradients substituted.

The use of iron tubes in freight engines grew in favor, and in October, 1847, Mr. Baldwin noted that he was fitting his flues with copper ends, "for riveting to the boiler."